CALIFORNIA
HEALTH BENEFITS REVIEW PROGRAM

Analysis of Senate Bill 1223: Hearing Aids for Children

A Report to the 2006–2007 California Legislature
April 3, 2006

CHBRP 06-03

Established in 2002 to implement the provisions of Assembly Bill 1996 (*California Health and Safety Code*, Section 127660, et seq.), the California Health Benefits Review Program (CHBRP) responds to requests from the State Legislature to provide independent analysis of the medical, financial, and public health impacts of proposed health insurance benefit mandates. The statute defines a health insurance benefit mandate as a requirement that a health insurer and/or managed care health plan (1) permit covered individuals to receive health care treatment or services from a particular type of health care provider; (2) offer or provide coverage for the screening, diagnosis, or treatment of a particular disease or condition; or (3) offer or provide coverage of a particular type of health care treatment or service, or of medical equipment, medical supplies, or drugs used in connection with a health care treatment or service.

A small analytic staff in the University of California's Office of the President supports a task force of faculty from several campuses of the University of California, as well as Loma Linda University, the University of Southern California, and Stanford University, to complete each analysis within a 60-day period, usually before the Legislature begins formal consideration of a mandate bill. A certified, independent actuary helps estimate the financial impacts, and a strict conflict-of-interest policy ensures that the analyses are undertaken without financial or other interests that could bias the results. A National Advisory Council, made up of experts from outside the state of California and designed to provide balanced representation among groups with an interest in health insurance benefit mandates, reviews draft studies to ensure their quality before they are transmitted to the Legislature. Each report summarizes sound scientific evidence relevant to the proposed mandate, but does not make recommendations, deferring policy decision making to the Legislature. The State funds this work though a small annual assessment of health plans and insurers in California. All CHBRP reports and information about current requests from the California Legislature are available at CHBRP's Web site, www.chbrp.org.

A Report to the 2006–2007 California State Legislature

Analysis of Senate Bill 1223
Hearing Aids for Children

April 3, 2006

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PREFACE

This report provides an analysis of the medical, financial, and public health impacts of Senate Bill 1223, a bill that would require health care service plan contracts sold in the group market, and insurance policies sold in the group and individual market to provide up to $1,000 coverage every 36 months for hearing aids to all enrollees younger than 18 years of age. In response to a request from the California Senate Committee on Banking, Finance and Insurance on February 2, 2006, CHBRP undertook this analysis pursuant to the provisions of Assembly Bill 1996 (2002) as chaptered in Section 127600, et seq., of the California Health and Safety Code.

Wade Aubry, MD, Janet Coffman, PhD, Patricia Franks, BA, Harold Luft, PhD, and Edward Yelin, PhD, all of the University of California, San Francisco, prepared the medical effectiveness analysis. Kristina W. Rosbe, MD, FAAP, provided technical assistance with the literature review and clinical expertise for the medical effectiveness analysis. Penny Coppernoll-Blach, MLIS, of University of California, San Diego, conducted the literature search. Nicole Bellows, MHSA, Helen Halpin, PhD, Sara McMenamin, PhD, all of the University of California, Berkeley, prepared the public health impact analysis. Ying-Ying Meng, DrPH, Meghan Cameron, MPH, Gerald Kominski, PhD, and Nadereh Pourat, PhD, of the University of California, Los Angeles, prepared the cost impact analysis. Robert Cosway, FSA, MAAA, of Milliman, provided actuarial analysis. Susan Philip, MPP, of CHBRP staff prepared the background section and synthesized individual sections into a single report. Cherie Wilkerson, BA, provided editing services. In addition, a subcommittee of CHBRP's National Advisory Council (see final pages of this report) and a member of the CHBRP Faculty Task Force, Thomas Valente, PhD, of the University of Southern California, reviewed the analysis for its accuracy, completeness, clarity, and responsiveness to the Legislature's request.

CHBRP gratefully acknowledges all of these contributions, but assumes full responsibility for all of the report and its contents. Please direct any questions concerning this report to CHBRP:

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Jeff Hall
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EXECUTIVE SUMMARY

California Health Benefits Review Program Analysis of Senate Bill 1223: Hearing Aids for Children

The California Legislature has asked the California Health Benefits Review Program (CHBRP) to conduct an evidence-based assessment of the medical, financial, and public health impacts of Senate Bill 1223. In response to a request from the California Senate Committee on Banking, Finance and Insurance on February 2, 2006, CHBRP undertook this analysis pursuant to the provisions of Assembly Bill 1996 (2002) as chaptered in Section 127600, et seq., of the California Health and Safety Code.

SB 1223 would add section 1367.195 to the Health and Safety Code and Section 10123.75 to the Insurance Code. SB 1223 would require Knox-Keene licensed health care service plan contracts sold in the group market, and insurance policies sold in the group and individual market to cover up to $1,000 towards the cost of hearing aids to all enrollees younger than 18 years of age. Coverage may be restricted to "one claim during a 36-month period."[1]

The bill defines hearing aids as "any nonexperimental, wearable instrument or device designed for the ear and offered for the purpose of aiding or compensating for impaired human hearing, but excluding batteries and cords". SB 1223 does not restrict plans and insurers in their contracting and reimbursement arrangements for coverage of hearing aids or in conducting managed care, medical necessity, or utilization review of these devices in the same manner that plans and insurers use for other services and devices.

SB 1223 contains the same language as SB 1158 (2004) and a modification of SB 174 (2003), both of which were analyzed by CHBRP.[2] This analysis updates the previous analyses by applying CHBRP's established analytic methods and including newly available literature and data.

I. Medical Effectiveness

- Hearing aids are helpful to many people who have hearing impairments.

- Interventions to treat hearing loss in children involve fitting children with hearing aids, training parents and teachers how to communicate with these children, and training children in use of hearing aids for maximum speech and language development.

[1] Health care service plans, commonly referred to as health maintenance organizations (HMOs), are regulated and licensed by the California Department of Managed Care (DMHC), as provided in the Knox-Keene Health Care Services Plan Act of 1975. The Knox-Keene Health Care Services Plan Act is codified in the California Health and Safety Code. Health insurance policies are regulated by the California Department of Insurance and are subject to the California Insurance Code.

[2] The previous CHBRP analyses of SB 1158 (2004) and SB 174 (2003) are available at http://www.chbrp.org/analyses.html.

- Studies of children with hearing loss indicate a pattern toward favorable effects of early diagnosis and treatment, but improvements in outcomes cannot be attributed solely to hearing aids.

    - Children whose hearing loss is diagnosed and treated prior to 6 months of age have more intelligible speech, larger vocabularies, stronger verbal reasoning skills, and greater comprehension of other persons' speech compared to children who receive intervention after six months of age.
    - The speech and language development of children whose hearing loss is diagnosed and treated prior to 6 months of age parallels that of children with normal hearing.
    - Children whose hearing loss is diagnosed and treated at an earlier age also score higher on tests of non-verbal interaction.
    - Evidence of the effects of early diagnosis and treatment on personal and social development is ambiguous.
    - Effects on speech, language, non-verbal interaction, and personal/social development cannot be attributed solely to hearing aids, because most children who have been studied were enrolled in educational intervention programs at the same time they were fitted with hearing aids.

- Some more sophisticated hearing aid technologies improve outcomes for children with hearing loss versus older technologies with one exception. (These technologies are described in the Medical Effectiveness section of the report.)

II. Utilization, Cost, and Coverage Impacts

Approximately 109,000 children (ages 0–17 years) in California have hearing impairments and are enrolled in plans subject to SB 1223. This includes children enrolled in private Knox-Keene licensed plans in the group market and in health policies regulated under the California Department of Insurance. This also includes children in the California Public Employees' Retirement System (CalPERS), Medi-Cal, or Healthy Families. Those in the individual health maintenance organization (HMO) market are not subject to SB 1223 and are therefore not included in this analysis. The utilization, cost, and coverage impact analyses indicate:

- About 46.3% of children with hearing impairments in California have more extensive coverage than proposed under SB 1223. This means that such children have a hearing aid benefit that may cover more than $1,000, may include coverage on an annual basis, or may include coverage for accessories, etc. An estimated 6.8% of children have coverage similar to the proposed mandate. The remaining 46.9% of children with hearing impairments do not have coverage for hearing aids.

- Based on the data from Gallaudet Research Institute's survey, the current hearing-aid utilization rate for children who have hearing impairments is 56.1% in California. CHBRP did not identify a source that provided separate hearing-aid utilization rates for those with and without insurance coverage for hearing aids. However, a survey conducted by the Listen

Up organization found that approximately 1% of respondents cited cost as a barrier to obtaining a hearing aid for a hearing impaired child. Because cost barriers are more likely to affect those without coverage, this translates into a 2% reduction in utilization for this group from the state average. As a result, CHBRP estimates a 58% rate of utilization for children *with coverage* for hearing aids and a 54% rate for children *without coverage*. Utilization of hearing aids by children without coverage is expected to increase by approximately four percentage points under the mandate to equal the same level of utilization by children with coverage. The utilization rate among those with coverage is expected to remain the same.

- The mandate is estimated to increase total net annual expenditures by $3.383 million or 0.01%. The mandate will increase premiums by $7.252 million ($5.012 million for the portion of group insurance premiums paid by private employers, $1.573 million for the portion of group insurance, CalPERS, and Healthy Families premiums paid by enrollees, and $667,000 for individually purchased insurance). There is a net reduction in out-of-pocket expenditures of $3.869 million at the same time. This estimate should be viewed as an upper bound since the estimate is based on a pair of hearing aids at $5,000 per pair, although some children may only need one hearing aid or may go with a less expensive model. The health insurance premiums are estimated to increase *on average* by 0.013% or $0.0135 per member per month (PMPM).

- Increases in insurance premiums vary by market segment. Healthy Families, Medi-Cal, and CalPERS provide full or similar coverage for this benefit currently and will not experience expenditure increases. In the remaining market segments, increases measured by percentage changes in premiums are estimated to range from approximately 0.007% to 0.039%. Increases as measured by PMPM premiums are estimated to range from approximately $0.0244 to $0.059. The greatest impact on premiums would be in the small-group and individual PPO markets.

Table 1. Summary of Coverage, Utilization, and Cost Impacts of SB 1223

	Before Mandate	After Mandate	Increase/ Decrease	% Change After Mandate
Coverage				
Number of insured children with hearing impairments aged 0–17 yrs in California with coverage and subject to the mandate	109,000	109,000	0.0%	0.0%
Percentage of insured children aged 0–17 yrs with coverage for hearing aids				
Coverage better than mandated levels	46.3%	46.3%	0.0%	0.0%
Coverage similar to mandated levels	6.8%	53.7%	46.9%	685.1%
No coverage	46.9%	0.0%	(46.9%)	(100.0%)
Number of insured children with hearing impairments aged 0–17 yrs in California with coverage for hearing aids				
Coverage better than mandated levels	50,000	50,000	0.0%	0.0%
Coverage similar to mandated levels	7,000	58,000	51,000	728.6%
No coverage	51,000	0	(51,000)	(100.0%)
Utilization and cost				
Number of children aged 0–17 yrs receiving hearing aids per year				
Coverage better than mandated levels	5,800	5,800	0.0%	0.0%
Coverage similar to mandated levels	900	6,800	5,900	655.6%
No coverage	5,500	0	(5,500)	(100.0%)
Total number receiving hearing aids per year	12,200	12,600	400	3.3%
Average cost per pair of hearing aids (per person)	$5,000	$5,000	$0	0.0%
Average lifetime of hearing aids (years)	5	5		0.0%
Expenditures				
Premium expenditures by private employers for group insurance	$35,792,975,000	$35,797,987,000	$5,012,000	0.01%
Premium expenditures for individually purchased insurance	$1,702,582,000	$1,703,249,000	$667,000	0.04%
CalPERS employer expenditures	$2,330,367,000	$2,330,367,000	$0	0.00%
Medi-Cal state expenditures	$4,334,532,000	$4,334,532,000	$0	0.00%
Healthy Families state expenditures	$644,314,000	$644,314,000	$0	0.00%
Premium expenditures by individuals with group insurance, CalPERS, or Health Families	$11,378,584,000	$11,380,157,000	$1,573,000	0.01%
Individual out-of-pocket expenditures (deductibles, copayments, etc.)	$3,652,362,000	$3,675,975,000	$23,613,000	0.65%
Expenditures for non-covered services	$27,482,000	$0	($27,482,000)	(100.0%)
Total annual expenditures	$59,863,198,000	$59,866,581,000	$3,383,000	0.01%

Source: California Health Benefits Review Program, 2006.
Note: The population includes individuals and dependents in California who have private insurance (group and individual) or are enrolled in public plans subject to the Health and Safety Code, including CalPERS, Medi-Cal, or Healthy Families. All population figures include enrollees aged 0–64 years and enrollees 65 years or older covered by employment-based coverage. Employees and their dependents who receive their coverage from self-insured firms are excluded because these plans are not subject to mandates.
Key: CalPERS = California Public Employees' Retirement System; HMO = health maintenance organization and point of service plans; PPO = preferred provider organization and fee-for-service plans.

III. Public Health Impacts

- An estimated 1.7% of children in the United States are affected by hearing loss.

- It is projected that approximately 400 additional children will receive hearing aids each year as a result of SB 1223. These children are new users of hearing aids and are subsequently expected to have improved hearing following the mandate.

- In addition to improved hearing, the use of hearing aids in conjunction with educational interventions can also result in improved speech and language development. Although the interventions that aim to improve speech and language development have been found to be effective, they tend to include the use of hearing aids in conjunction with other educational components not specified in SB 1223. Therefore, although the passage of SB 1223 would likely contribute to better speech and language outcomes, improvements in these areas cannot be attributed to the acquisition of hearing aids alone.

- Male children have higher prevalence rates of hearing problems compared to female children. Additionally, Hispanic children have a higher prevalence of hearing problems compared to non-Hispanic children. The gender and ethnic differences in hearing problem prevalence among children diminish when more stringent definitions of hearing loss are used. No literature was identified that discussed racial or ethnic disparities with regard to receipt of hearing aids. As such, there is no evidence to suggest that SB 1223 will have a substantial impact on racial disparities.

- Estimates on the lifetime costs associated with hearing loss typically focus on those with severe or profound hearing loss and costs vary from $297,000 per person in one study to $417,000 per person in another. In addition to medical costs, lifetime cost estimates include special education costs and costs associated with reduced productivity. No literature was identified that examined economic cost savings associated with hearing aids. As such, although it is possible that SB 1223 could contribute to decreased special education and productivity costs associated with hearing loss, there is no evidence in the literature to support this conclusion.

INTRODUCTION

According to the National Institute on Deafness and Other Communication Disorders, hearing loss affects approximately 28 million individuals across the United States. Approximately 17 in 1,000 children have a hearing impairment (NIDCD, 2006). SB 1223 would require Knox-Keene licensed health care service plan contracts sold in the group market, and health insurance policies sold in the group and individual market to cover up to $1,000 in costs for hearing aids to all enrollees younger than 18 years of age.[3] In California, approximately 109,000 children who are enrolled in plans and policies subject to the mandate have hearing impairments

Under SB 1223, coverage may be restricted to "one claim during a 36-month period." The bill defines hearing aids as "any nonexperimental, wearable instrument or device designed for the ear and offered for the purpose of aiding or compensating for impaired human hearing, but excluding batteries and cords". SB 1223 does not restrict plans and insurers in their contracting and reimbursement arrangements or in conducting managed care, medical necessity, or utilization review.

This bill contains the same language as SB 1158 (2004) and a modification of SB 174 (2003), both of which were analyzed by the California Health Benefits Review Program (CHBRP).[4] This analysis updates the previous analyses by applying CHBRP's established analytic methods and including newly available literature and data. SB 1158 passed the California State Legislature and was vetoed by Governor Arnold Schwarzenegger on September 22, 2004.

Current law does not specifically contain coverage requirements for hearing aids. Private health plans and insurers in California do not generally cover hearing aids (although they cover a hearing assessment to determine the need for hearing aids, and medically necessary surgeries to correct hearing impairments). In the publicly insured market, both Medi-Cal and Healthy Families cover hearing aids for children at higher levels than that proposed under SB 1223. California Public Employees' Retirement System (CalPERS) also provides coverage for hearing aids for children, and the mandated benefit proposed under SB 1223 was designed to mirror that of CalPERS.

Eight states, including Connecticut, Kentucky, Louisiana, Maryland, Missouri, Minnesota, Oklahoma, and Rhode Island, currently mandate coverage for hearing aids for children (BCBSA 2005, Missouri Rev. Statutes 376.1220). Several states, including New York, Oregon, and Maine, have introduced similar legislation over the last three years that was defeated in the legislature or vetoed. The trend for these mandate laws is to require coverage for children at a prescribed dollar benefit limit over a specified time period. For example, Maryland mandates coverage for children limited to $1,400 per hearing aid every 36 months.

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[3] SB 1223 would add section 1367.195 to the Health and Safety Code and Section 10123.75 to the Insurance Code. Health care service plans, commonly referred to as health maintenance organizations (HMOs), are regulated and licensed by the California Department of Managed Care (DMHC), as provided in the Knox-Keene Health Care Services Plan Act of 1975. The Knox-Keene Health Care Services Plan Act is codified in the California Health and Safety Code. Health insurance policies are regulated by the California Department of Insurance and are subject to the California Insurance Code.

[4] The previous CHBRP analyses of SB 1158 (2004) and SB 174 (2003) are available at http://www.chbrp.org/analyses.html.

Hearing Loss and Early Detection

Hearing loss may be conductive or sensorineural. Conductive hearing loss (usually affecting low-frequency hearing) may be caused by a foreign body, edema of the auditory canal,[5] or otitis media.[6] Sensorineural hearing loss occurs when there is damage to the inner ear hair cells or a damaged hearing nerve. Sensorineural hearing loss can be caused by noise, injury, certain medications, tumors, genetic causes, jaundice, meningitis, or problems with blood circulation. The most common cause of conductive hearing loss among children is ear infections. Sensorineural hearing loss in children is most commonly congenital of unknown etiology.

Hearing loss can range from "mild" to "profound." The following table describes the levels of hearing loss.

Table 2. Levels of Hearing Loss

Level of Hearing Loss	Decibel Level	Description
Mild	15–40 dB	Cannot hear a whispered conversation in a quiet atmosphere at close range.
Moderate	40–60 dB	Cannot hear normal conversation in a quiet atmosphere at close range.
Severe	60–90 dB	Cannot hear speech; can only hear loud noises such as a vacuum cleaner or lawn mower at close range.
Profound	over 90 dB	Cannot hear speech; may only hear extremely loud noises such as a chain saw at close range or the vibrating component of loud sound.

Source: American Academy of Otolaryngology–Head and Neck Surgery Foundation, Inc., 2006b.

In order for hearing loss to be treated, it must be detected. According to the National Institute on Deafness and Other Communication Disorders, approximately 33 children per day are born with significant hearing impairment and many of these children are not identified until about age two (NIDCD 2006). To address this concern of undetected hearing loss in newborns, 27 states and the District of Columbia provide for the establishment of mandatory early hearing screening programs (NCSL 2006). In California, Children's Medical Services, of the California Department of Health Services (DHS), implemented a newborn screening program under the requirements of Section 123975 of the Health & Safety Code (Newborn and Infant Hearing Screening, Tracking and Intervention Act 1998). This provided for the establishment of a screening program for all newborns and infants delivered in general acute care hospitals participating in the California Children's Services Program. According to DHS, this program, when it is fully implemented, will include about 200 participating hospitals out of about 500 general acute care hospitals statewide, or approximately 70% of all births (DHS 2004).[7]

[5] "Edema" refers to the presence of an abnormally large amount of fluid in intercellular tissue spaces, such as the auditory canal.

[6] "Otitis media" refers to a middle ear infection or inflammation and is often accompanied by a common cold, flu, or other respiratory tract infection.

[7] The number of general acute care hospitals in California was taken from the Office of Statewide Health Planning and Development, Healthcare Quality and Analysis Division at

Types of Hearing Aids Available in the Market
There are four different styles of hearing aids for people with hearing loss.

- In-the-Ear (ITE) hearing aids are used for mild-to-severe hearing loss. A tough plastic case holds the components of the hearing aid. ITE aids accommodate technical mechanisms such as a telecoil, which is a small magnetic coil used in hearing aids that can improve hearing during telephone calls. ITE hearing aids can be damaged by earwax and ear drainage. Because they are small, they can also cause problems resulting from growth changes and unwanted feedback. ITE aids are not usually worn by children because the casings need to be replaced as the ear grows, and children grow rapidly.
- Behind-the-Ear (BTE) hearing aids are worn behind the ear and are connected to a plastic mold that fits inside the ear. The hearing aid components are held in a case behind the ear. Sound travels through the mold into the ear. BTE aids are used by people of all ages for mild-to-profound hearing loss. Poorly fitting BTE ear molds may cause disturbing feedback, such as a whistle sound caused by the fit of the hearing aid or by build-up of earwax or fluid. BTE aids are used regularly in children.
- Canal aids fit into the ear canal and are available in two sizes. In-the-Canal (ITC) hearing aids are customized to fit the size and shape of the ear canal and are used for mild or moderately severe hearing loss. Completely-in-Canal (CIC) hearing aids are largely concealed in the ear canal and are used for mild-to-moderately severe hearing loss. Their small size makes canal aids difficult to adjust, remove, and hold additional technical devices, such as a telecoil. Because canal aids can also be damaged by earwax and ear drainage, they are not typically recommended for children.
- Body aids are used by people with profound hearing loss. The aid is attached to a belt or a pocket and connected to the ear by a wire. Its large size enables the aid to hold additional technical devices and have other signal-processing options. Although suitable for children or adults, body aids are usually used only when other types of aids cannot be used or are not effective.

The type of hearing aid that is most suitable for children is BTE, which is appropriate for those with mild-to-profound levels of hearing loss. BTEs fall within the category of “traditional air conduction hearing aids” since they use the conduction of air to facilitate hearing.

Hearing aids also vary by the type of circuitry or electronics used within. The type of circuitry or electronics, rather than the type of hearing aid, is what influences the total price of the hearing aid. There are three types of circuitry/electronics used within hearing aids:

- Analog/adjustable aids allow the audiologist to determine the volume and other specifications needed, and then a separate laboratory builds the aid according to the audiologist’s specifications. The audiologist has some flexibility in making adjustments to the aid. These are the least expensive hearing aids.

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http://www.oshpd.ca.gov/HQAD/Hospital/FacilityLists/HospitalList_1205.xls accessed on March 27, 2006.

- Analog/programmable aids allow the audiologist to use a computer to program the hearing aid. The mechanisms behind analog/programmable hearing aids accommodate more than one environmental setting. If the aid is equipped with a remote control device, the wearer can change the program to accommodate a given listening environment. Analog/programmable circuitry can be used in all styles of hearing aids.
- Digital/programmable aids use a microphone, receiver, battery, and computer chip. The audiologist programs digital hearing aids with a computer. The sound quality and response time can be adjusted on an individual basis. Digital hearing aids allow the audiologist to be flexible in making adjustments to the hearing aids. Digital circuitry can be used in all styles of hearing aids and are the most expensive (NIDCD 2006).

I. MEDICAL EFFECTIVENESS

Interventions to treat hearing loss in children involve fitting children with hearing aids and providing educational interventions for children and their caregivers. Hearing aids help children with hearing loss by amplifying sounds. In the United States, the federal Individuals with Disabilities Education Act (IDEA) requires local school districts to provide educational interventions to children with hearing loss. These interventions include training in the use of hearing aids, auditory development, speech development, and language development. Families of children with hearing loss are often given counseling and training in stimulation of speech and effective communication. Interventions may also include sign language if a child has profound hearing loss. Most intervention programs for hearing loss among young children provide a combination of home- and school-based services (Carney and Moeller, 1998).

The medical effectiveness review for SB 1223 focuses on traditional air conduction hearing aids because they are the types of hearing aids most frequently used by children with hearing loss (Gabbard and Schryer, 2003, p. 237; Palmer and Ortmann. 2005, p. 907). SB 1223 may also apply to bone conduction hearing aids and vibrotactile aids, wearable devices that are used by persons who are not helped by air conduction hearing aids.[8] *The review does not assess the effects of bone-anchored hearing aids or cochlear implants because SB 1223 only addresses external, wearable devices.* Both bone-anchored hearing aids and cochlear implants are surgically implanted. The review also does not examine frequency modulation (FM) systems that are used in combination with hearing aids to improve children's ability to hear teachers or other speakers, because school districts typically supply these devices to children.[9] In addition, this review does not evaluate the effectiveness of screening for hearing loss or the quality of the educational interventions provided to children with hearing loss and their families, because SB 1223 only addresses coverage for hearing aids.

Studies of the medical effectiveness of hearing aids were identified through searches of the following databases: PubMed, the Cochrane databases, PsycInfo, Sociological Abstracts, Social Sciences Citation Index, and the Educational Resources Information Center (ERIC). Web of Science was searched for articles that cited particularly valuable older articles. The search was limited to abstracts of peer-reviewed studies of children with hearing loss, defined as subjects aged 0–18 years. The search was limited to studies of children with hearing loss because SB 1223 would require health plans to cover hearings aids only for children and because characteristics of hearing loss in children and adults differ (Eisenberg et al., 2000; Pittman and Stelmachowicz, 2003; Stelmachowicz et al., 2004). These differences suggest that findings from studies of adults with hearing loss should not be generalized to children with hearing loss.

A more thorough description of the methods used to conduct the medical effectiveness review and the process used to grade the evidence for each outcome measure may be found in Appendix A: Literature Review Methods. Tables presenting detailed findings for each outcome measure may be found in Appendix B: Summary of Medical Effectiveness Findings on Hearing Aids for Children.

[8] Gabbard and Schryer (2003, p. 237), Gatehouse (2002, p. 154), and Palmer and Ortmann (2005, pp. 907–908) provide further information about bone conduction hearing aids, bone-anchored hearing aids, and cochlear implants.
[9] Palmer and Ortmann (2005, pp. 911–912) describe FM systems and other assistive listening devices.

It is generally accepted that the use of hearing aids in children with hearing loss improves their ability to hear. As a result, there have been few recent studies on the impact of hearing aids on hearing in children. This review examined the two major categories of recent studies on children with hearing loss: 1) studies of the relationship between age at initial diagnosis and treatment of hearing loss, and children's speech, language, and social development, and 2) studies of the relative effectiveness of hearing aids that differ with respect to the type of circuitry and various other technologies.

Studies of the relationship between age at diagnosis and treatment examined the following outcomes.

- Speech development outcomes
- Language development outcomes
- Personal/social development outcomes

Studies of the relative effectiveness of different types of hearing aid technologies evaluated the following technologies. These technologies are described on pages 17-20 in conjunction with the summary of the literature.

- Compression
- Directional microphone
- Digital feedback suppression
- Frequency transpositioning
- Spectral enhancement

Outcomes of different types of hearing aid technologies assessed include:

- Hearing outcomes
- Speech outcomes
- Satisfaction outcomes
- Parent and teacher assessment of outcomes

The literature review did not discover any randomized controlled trials of children with hearing loss that assess the effects of early diagnosis and treatment of hearing loss or of the relative effectiveness of different hearing aid technologies. One large, well-designed randomized controlled trial of three common types of hearing aid circuits was found but was excluded from the analysis because the subjects were adults with a mean age of 62 years (Larson et al., 2000). All of the studies of the effectiveness of early diagnosis and treatment were observational studies that did not include control groups of children with hearing loss who did not receive hearing aids or other interventions. Most studies examined a single group of children with hearing loss or two or more groups of children who were grouped by the age at which the children were diagnosed with hearing loss and/or fitted with hearing aids. The studies of different hearing aid technologies were also observational studies without control groups. Some studies compared a more advanced hearing aid to children's own hearing aids. Other studies compared hearing aids with two or more different types of technologies.

The lack of randomized controlled trials reflects challenges inherent in conducting research on treatment of hearing loss in children. Hearing aids and educational interventions have been the

standard of care for children with hearing loss for so long that some researchers believe it is unethical to deny or delay access to these devices and services (Downs and Yoshinaga-Itano, 1999). Parents and other caregivers may refuse to enroll children in studies in which they might not receive standard treatments for hearing loss (Yoshinaga-Itano et al., 1998). In addition, as a result of the federal IDEA, children whose caregivers suspect hearing loss are entitled to receive a timely evaluation and intervention. This requirement has been interpreted to forbid enrollment of children with hearing loss in randomized trials (Yoshinaga-Itano, 2003, Yoshinaga-Itano, 2004). The barriers to conducting randomized controlled trials of hearing loss treatments for children are formidable and perhaps insurmountable. These barriers result in a research base that is not as rigorous as that available for many other diseases and conditions, which limits the certainty of conclusions drawn from this literature.

Findings

Studies of the relationship between age at intervention to address hearing loss and child development

Ten studies have examined the relationship between age at intervention and outcomes for children with hearing loss. The results of these studies are relevant to assessing the potential benefits of SB 1223 because obtaining coverage for hearing aids may make it easier for caregivers to purchase hearing aids for children as soon as hearing loss is diagnosed. However, these studies do not enable one to separate the effects of early receipt of hearing aids from the effects of early receipt of educational interventions. In most of the studies reviewed, children were enrolled in educational intervention programs at the same time that they were fitted with hearing aids because the standard of care for treatment of children with hearing loss calls for children to receive both hearing aids and educational interventions. One cannot determine whether the outcomes would be the same if the children studied had only received hearing aids.

Speech outcomes

Three studies have examined the effects of age at intervention to treat hearing loss on speech outcomes. Eilers and Oller (1994) investigated the relationship between the age at which infants with severe or profound hearing loss were first fitted with hearing aids and the age at which they began to produce well-formed syllables during vocalization (e.g., “dada,” “ma”). There was a statistically significant and negative relationship between age at fitting with hearing aids and age at which children began producing well-formed syllables. The younger a child was when fitted with hearing aids, the younger the age at which he or she began to speak in well-formed syllables. Calderon and Naidu (1999) assessed speech production by pre-school children who had participated in an intervention program that included hearing aids and speech and language training. They compared children who enrolled in the intervention by age 12 months to children enrolled between ages 13 and 36 months. The bivariate correlation between age at intervention and scores on a test of speech production was not statistically significant. However, the relationship was negative and statistically significant in a multivariate regression that controlled for the level of hearing loss, another variable that affects speech production. In other words, when the level of hearing loss was taken into account, children who enrolled in the intervention

at a younger age had better speech production. Markides (1986) examined teachers' ratings of speech produced by school-aged children with hearing loss. The children were divided into four groups according to the age at which they were first fitted with hearing aids: 6 months or younger, 7 to 12 months, 1 to 2 years, and 2 to 3 years. Teachers rated a significantly higher proportion of children who were first fitted with hearing aids within the first 6 months of life as having speech that was very easy or fairly easy to understand compared with children who were first fitted with hearing aids after they were 6 months old. There were no statistically significant differences in ratings of speech produced by children in the three age groups who were first fitted with hearing aids after 6 months of age. Thus, the evidence suggests that early diagnosis and treatment of hearing loss decreases the age at which children begin to form syllables and improves the intelligibility of their speech.

Language development outcomes

Eight studies have assessed the effects of age at intervention to treat hearing loss on language development. Six studies assessed the impact of age at intervention on children's receptive vocabularies (i.e., comprehension of spoken words and sentences). Five studies found that children who were treated for hearing loss at a younger age had significantly higher scores on tests of receptive vocabulary (Calderon and Naidu, 1999; Moeller, 2000; Yoshinaga-Itano and Apuzzo, 1998a; Yoshinaga-Itano and Apuzzo, 1998b; Yoshinaga-Itano et al., 1998).[10] Another study found that children whose hearing loss was diagnosed by age 2 months had higher scores on a test of receptive vocabulary than children diagnosed after age 2 months, but the difference was not statistically significant (Apuzzo and Yoshinaga-Itano, 1995). A study of children with severe-to-profound hearing loss who were tested at age 3 to 5 years and again at age 6 to 9 years found that children whose hearing loss was diagnosed and treated at a younger age had larger receptive vocabulary at initial testing. However, there was no significant association between age at intervention and receptive vocabulary when children were retested 3 to 4 years later (Musselman et al., 1988). The results of this study suggest that the effects of early intervention do not persist over time. However, another study of children with a mean age of 5 ½ years reached the opposite conclusion (Calderon and Naidu, 1999). The authors reported that children whose hearing loss was diagnosed and treated by age 13 months had better receptive language skills, which suggests that gains from early intervention persist over time. The reasons for this discrepancy are unclear but may be related to differences in children's age at intervention and testing or to differences in the characteristics of the interventions in which they participated.

Two studies suggest that early diagnosis and treatment may enable children with hearing loss to develop language skills that are equal to those of many children with normal hearing. Yoshinaga-Itano and Apuzzo (1998b) found that children with normal cognitive function whose hearing loss was diagnosed and treated by age 6 months had receptive vocabularies that were similar to the average receptive vocabularies of children with normal hearing of the same age. Similarly, Moeller (2000) reported that 5-year old children whose hearing loss was diagnosed and treated by age 11 months had receptive vocabularies within the average range for 5-year old children

[10] The four studies by Yoshinaga-Itano and colleagues (Apuzzo and Yoshinaga-Itano, 1995; Yoshinaga-Itano and Apuzzo, 1998a; Yoshinaga-Itano and Apuzzo, 1998b; and Yoshinaga-Itano et al., 1998) analyzed existing data regarding children with hearing loss who were enrolled in the Colorado Home Intervention Program. The samples of children analyzed in these studies may overlap.

with normal hearing. Thus, despite a few non-significant findings, overall the evidence suggests a pattern toward favorable effects of early diagnosis and treatment on receptive language.

Six studies examined the effects of age at intervention on children's expressive vocabularies (i.e., the vocabularies they use when communicating with others). Four studies reported that children whose hearing loss was diagnosed by age 6 months had significantly higher scores on tests of expressive vocabulary than children whose hearing loss was diagnosed after age 6 months (Apuzzo and Yoshinaga-Itano, 1995; Yoshinaga-Itano and Apuzzo, 1998a; Yoshinaga-Itano and Apuzzo, 1998b; and Yoshinaga-Itano et al., 1998). Yoshinaga-Itano and Apuzzo (1998b) also found that children with normal cognitive function whose hearing loss was diagnosed and treated by age 6 months had expressive vocabularies that were similar to the average expressive vocabularies of children with normal hearing of the same age. Calderon and Naidu (1999) reported that children with a mean age of 3 years whose hearing loss was diagnosed and treated by age 12 months had higher scores on a test of expressive vocabulary than children whose hearing loss was diagnosed and treated between ages 13 and 36 months. They obtained similar results when analyzing a group of children with a mean age of 5 ½ years. However, one study found no statistically significant relationship between age at intervention and scores on two tests of expressive vocabulary (Musselman et al., 1988). Nevertheless, the evidence overall suggests a pattern toward favorable effects of early diagnosis and treatment on expressive language.

Two studies analyzed other language outcomes. Moeller (2000) found that 5-year old children whose hearing loss was treated at an earlier age had higher scores on a test of verbal reasoning. Ramkalawan and Davis (1992) assessed measures of syntactic complexity, rate of verbal interaction, and clarity of communication for children with bilateral hearing loss who had a mean age of 57 months (4.75 years). Children who were fitted with hearing aids at a younger age had significantly larger vocabularies, asked a significantly higher proportion of questions in conversation, and spoke significantly more words per minute as measured by one of two instruments. Children who were fitted with hearing aids at a younger age also had greater mean length of utterance in morphemes in words (i.e., grammatically meaningful combinations of sounds), total utterance attempts per minute, and proportions of nonverbal utterances, and spoke more words per minute as measured by a second instrument, but the differences were not statistically significant.

Non-verbal interaction outcomes

Three studies examined the effect of age at intervention on non-verbal understanding and interactions. Examples of non-verbal interaction include observation, imitation, discrimination among objects, and motor behavior (Apuzzo and Yoshinaga-Itano, 1995, p. 129). Yoshinaga-Itano and Apuzzo (1998a) found that children whose hearing loss was diagnosed by age 6 months displayed significantly more advanced non-verbal comprehension and interaction than children whose hearing loss was diagnosed after age 6 months. Apuzzo and Yoshinaga-Itano (1995) reported that children diagnosed with hearing loss by age 2 months had more advanced non-verbal comprehension and interaction than children diagnosed after age 2 months, but the difference was not statistically significant. A study that compared children diagnosed with hearing loss by age 6 months to children diagnosed after age 18 months reported the same finding (Yoshinaga-Itano and Apuzzo, 1998b). Thus, the evidence suggests a pattern toward a

favorable effect of early intervention on non-verbal comprehension and interaction.

Personal/social development outcomes

Five studies investigated the effects of age at intervention to treat hearing loss on children's personal and social development. One study compared children with a mean age of 40 months (3.3 years) whose hearing losses were identified by six months of age to children whose hearing losses were identified after 6 months of age (Yoshinaga-Itano and Apuzzo, 1998a). That study found that children whose hearing loss was diagnosed by age six months had significantly higher levels of personal/social development. Apuzzo and Yoshinaga-Itano (1995) found that children evaluated at a mean age of 40 months whose hearing loss was identified by age 2 months had higher levels of personal/social development than children whose hearing loss was identified after age 2 months, but the difference was not statistically significant. A study that compared children diagnosed with hearing loss by age 6 months to children diagnosed after age 18 months reported the same finding (Yoshinaga-Itano and Apuzzo, 1998b). Musselman and colleagues' (1988) study of children who were tested at age 3 to 5 years and again at 6 to 9 years found that age at intervention did not have a significant effect on social development. Calderon and Naidu's (1999) study reported mixed results. Children with a mean age of 5 ½ years whose hearing loss was diagnosed and treated by age 13 months had higher scores on one instrument that measures social development than children diagnosed and treated later, but lower scores on another instrument. The results were not statistically significant for either instrument. The lack of consistent and significant findings indicates that the evidence of effects of early diagnosis and treatment of hearing loss on personal/social development is ambiguous.

Studies of the relative effectiveness of different types of hearing aids for children

Compression amplification

Traditionally, analog hearing aids have used linear amplification technology that provides the same amount of amplification regardless of the loudness of the sound to which a person is listening. As a consequence, amplification may not be adequate to enable a person to hear soft sounds or may amplify loud sounds to the point that they are uncomfortable and distorted (Kopun, 1995, p. 176). For many persons with sensorineural hearing loss, this problem is exacerbated because they have a narrower range "between the threshold of audibility and the loudness discomfort level" than persons with normal hearing (Palmer and Ortmann, 2005, p. 905). Although this problem can be addressed by changing the hearing aid's volume, children often have difficulty adjusting volume or may forget to readjust the volume when sound levels change.

Several technologies have been developed to ensure that hearing aids amplify all sounds at adequate and comfortable levels. Peak clipping is a process by which the hearing aid cuts off signals that are uncomfortably loud. While peak clipping prevents exposure to uncomfortably loud sounds, it can distort loud speech (Gabbard and Schryer, 2003, p. 238; Kopun,1995, p. 177). Output limiting applies less amplification when an amplified signal reaches a certain level (Gatehouse, 2002, p. 151; Kopun, 1995, p. 177). Multi-channel hearing aids amplify sounds differently depending on their frequency (Kopun, 1995, p. 177–178). Compression amplification

automatically reduces volume when an amplified signal reaches a fixed level and then returns the volume to a normal level as soon as the intense sound is over. Compression amplification can help persons hear high and low intensity sounds within a word or syllable more clearly (Boothroyd et al., 1988). Hearing aids with wide dynamic range compression automatically adjust the level of gain in hearing depending on the level of sound, increasing the gain for soft sounds and decreasing it for loud sounds (Gabbard and Schryer, 2003, p. 238; Palmer and Ortmann, 2005, p. 910). Use of digital signal processing enables hearing aids to have a lower threshold for automatic compression than possible with analog technology (Gabbard and Schryer, 2003, p. 238).

Six studies have examined the effects of hearing aids with compression amplification on children with hearing loss. Dreschler (1988) assessed peak clipping and single-channel compression amplification. Single-channel compression was associated with a 15 percentage point increase in speech intelligibility relative to peak clipping, but the authors do not report results of tests of statistical significance. Boothroyd and colleagues (1988) compared the effects of a combination of output and compression amplification to output limiting alone. They found that combining output limiting and compression led to a statistically significant decrease in speech recognition relative to output limiting alone. Bamford and colleagues (1999) examined two-channel hearing aids with low-frequency compression amplification and high-frequency linear amplification. The two-channel hearing aids were associated with a statistically significant increase in speech recognition in a noisy environment relative to the children's own single-channel hearing aids. The two-channel hearing aids were also associated with an increase in speech recognition in a quiet environment, but the increase was not statistically significant. The children were also significantly more satisfied with the two-channel hearing aids. Flynn and colleagues (2004) compared digital hearing aids with multi-channel non-linear compression amplification to children's own analog hearing aids. The children in their study had significantly lower audibility thresholds and significantly better scores on speech recognition tests when using the digital multi-channel hearing aids than with their own analog hearing aids. Children rated the digital multi-channel hearing aids more highly in seven out of eight types of listening situations and in four situations the differences were statistically significant (i.e, listening in noise, outdoors, to television, and to music). Parents rated the digital multi-channel hearing aids more highly in all eight listening situations and in six situations the differences were statistically significant (i.e., listening in quiet, in noise, at a distance, to television, to music, and to vehicles approaching).

Marriage and Moore (2003) compared linear amplification to wide-dynamic range compression amplification. They found that children scored higher on a test in which they were asked to select a picture that corresponded to a spoken word when using wide-dynamic range compression than when using linear amplification, and that the difference was statistically significant for all children studied regardless of their level of hearing loss. Children also scored higher on a test in which they were asked to repeat spoken words, but the difference was statistically significant only for children with severe hearing loss. Another study by Marriage and colleagues (2005) evaluated the use of three amplification strategies with digital hearing aids: peak clipping, output limiting, and wide-dynamic range compression. For children with profound hearing loss, wide-dynamic range compression was associated with significantly higher scores on one test of speech recognition than those obtained when using peak clipping or output limiting. Children with severe hearing loss did not score as well on this test when using wide dynamic range

compression, but the difference was not statistically significant. Children with profound hearing loss also achieved higher scores on three other speech recognition tests when using hearing aids with wide-dynamic range compression, but the differences were not statistically significant.

Thus, these studies suggest single-channel and two-channel compression amplification have patterns toward favorable effects on speech recognition and children's satisfaction with hearing aids. There is a pattern toward favorable effects of wide-dynamic range compression on the speech recognition among children with profound hearing loss, but a pattern toward unfavorable effects for children with severe hearing loss. The single study of the effects of combining output limiting and compression suggests that combining these technologies reduces speech recognition.

Dual microphones

Traditionally, hearing aids had omni-directional microphones that amplify sounds from all directions at the same level. Amplifying all sounds at the same level may make it difficult for a person wearing a hearing aid to focus on any single voice, which can frustrate attempts at conversation. Some hearing aids have two or more directional microphones. Hearing aids with dual microphones reduce the volume of signals that come from the rear of a person wearing a hearing aid relative to the volume of signals from the front, enabling the hearing aid user to hear the person in front of him or her more clearly (Gabbard and Schryer, 2003, p. 237; Gatehouse, 2002, p. 148-149; Palmer and Ortmann 2005, p. 910).

Two studies have compared outcomes of hearing aids with dual microphones and omni-directional microphones for children with hearing loss. Gravel and colleagues (1999) assessed children with bilateral cochlear hearing loss. The children who participated in the study experienced a statistically significant improvement in hearing of words and sentences when using dual microphone hearing aids. Kuk and colleagues (1999) examined school-aged children with mild-to-profound hearing loss and found a statistically significant improvement in children's ability to hear words. The children also reported less difficulty in listening, but the difference was not statistically significant. The majority of teachers and parents reported that the hearing aids improved listening, comprehension of speech, and intelligibility of children's speech. The results of these studies suggest that dual microphones have favorable effects on speech recognition.

Digital feedback suppression

"Acoustic feedback occurs when sound that has been amplified by a hearing aid escapes from the ear and is reamplified" (Kopun, 1995, p. 179). Feedback is distracting for both the person with a hearing aid and other persons in close proximity. Many hearing aids have automatic feedback control features (Gabbard and Schryer, 2003, p. 238; Gatehouse, 2002, p. 150).

One study compared the effects of digital feedback suppression hearing aids on children with profound hearing loss to the children's own hearing aids (Henningsten et al., 1994). The children experienced statistically significant increases in gain in hearing in their left ears at all three high frequencies tested (1.5k, 2k, and 3k) relative to their own hearing aids. Hearing also increased in

children's right ears, but the increase in gain was statistically significant only at 2k. There were no statistically significant differences in hearing gain at low frequencies. This study suggests that feedback suppression technology has favorable effects on children's ability to hear high-frequency sounds.

Frequency transpositioning

Many children with severe-to-profound hearing loss are not helped by traditional amplification because they have such limited residual hearing at high frequencies that traditional amplification cannot make these sounds audible to them. Frequency transpositioning hearing aids are intended to help these children by converting high-frequency sounds to lower-frequency sounds (Kopun, 1995, p. 179). One study (Miller-Hansen et al., 2003) examined use of frequency transpositioning hearing aids by children with hearing loss. The authors found that use of a frequency transpositioning hearing aid yielded a statistically significant improvement in children's' ability to detect sound relative to their own hearing aids. There was also a statistically significant and positive association between use of a frequency transpositioning hearing aid and children's scores on a word recognition test. Thus, this study suggests that frequency transpositioning hearing aids have favorable effects on children's hearing and speech recognition.

Spectral enhancement

One study (Franck et al., 1999) examined the effects of spectral enhancement on children with hearing loss. Spectral enhancement modifies the speech signal by altering the time structure or the frequency spectrum of signals. The authors made three comparisons: hearing aids that do not process speech to hearing aids with spectral enhancement and multi-channel compression, spectral enhancement alone to spectral enhancement and multi-channel compression, and spectral enhancement with multi-channel compression to spectral enhancement with single-channel compression. Children's speech was significantly less intelligible when using hearing aids with spectral enhancement and multi-channel compression than when using hearing aids that did not process speech. The combination of spectral enhancement and multi-channel compression also yielded speech that was significantly less intelligible than speech produced when children wore hearing aids with spectral enhancement alone. There was no statistically significant difference in speech intelligibility when children wore hearing aids with spectral enhancement and multi-channel compression versus hearing aids with spectral enhancement and single-channel compression. Thus, this study suggests that the combination of spectral enhancement and multi-channel compression has unfavorable effects on the intelligibility of children's speech relative to unprocessed speech or spectral enhancement alone.

Summary of findings

The findings of this review of the literature on the effects of hearing aids on children with hearing loss may be summarized as follows.

Studies of the effects of early diagnosis and intervention

Studies of children with hearing loss indicate a pattern toward favorable effects of early diagnosis and treatment, but the improvements reported cannot be attributed solely to hearing aids.

- Children whose hearing loss is diagnosed and treated at an earlier age have more intelligible speech, larger vocabularies, stronger verbal reasoning skills, and greater comprehension of other persons' speech.
- Children whose hearing loss is diagnosed at an earlier age have receptive and expressive vocabularies that are within the average range for children of the same age whose hearing is normal.
- Children whose hearing loss is diagnosed and treated at an earlier age also score higher on tests of non-verbal interaction.
- Evidence of the effects of early diagnosis and treatment on personal and social development is ambiguous.
- Effects on speech, language, non-verbal interaction, and personal/social development cannot be attributed solely to hearing aids, because most children who have been studied were enrolled in educational intervention programs at the same time they were fitted with hearing aids.

Studies of the relative effectiveness of different hearing aid technologies

Some more sophisticated hearing aid technologies improve outcomes for children with hearing loss.

- Compression amplification has a pattern toward favorable effects on speech recognition.
- Multi-directional microphones have favorable effects on speech recognition.
- Feedback suppression has favorable effects on children's ability to hear high frequency sounds.
- Frequency transpositioning hearing aids have favorable effects on children's hearing and speech recognition.
- However, spectral enhancement of speech has unfavorable effects on the intelligibility of children's speech.

II. UTILIZATION, COST, AND COVERAGE IMPACTS

SB 1223 would require Knox-Keene licensed health care service plan contracts sold in the group market, and insurance policies sold in the group and individual market to cover up to $1,000 in costs for hearing aids to all enrollees younger than 18 years of age. Coverage may be restricted to "one claim during a 36-month period." This section will present first the current, or baseline, costs and coverage related to hearing aids for children, and then detail the estimated utilization, cost, and coverage impacts of SB 1223.

Present Baseline Cost and Coverage

Current utilization levels and costs of the mandated benefit

The National Institute on Deafness and Other Communication Disorders estimates that approximately 1.7% of children in the United States have a hearing impairment (NIDCD, 2006). Children with hearing impairments haven been remediated with hearing amplification devices for decades. Based on the data from Gallaudet Research Institute's *State Summary Report of Data from the 2004-2005 Annual Survey of Deaf and Hard of Hearing Children and Youth*, the current hearing-aid utilization rates for children who have hearing impairments are 59.2% for the nation and 56.1% for California (GRI, 2005). This rate includes children with and without coverage for hearing aids. The utilization rates of less than 100% are partially due to the fact that not all children with hearing impairment use hearing aid devices. Reasons for this include the following:

- **Not everyone can be helped with hearing aids.** Some children with profound levels of hearing loss will not be helped by the use of a hearing aid. For a portion of this population, cochlear implantation surgery may be a more effective vehicle to improve hearing-loss symptoms. Additionally, children who experience mild symptoms may have their hearing loss either go undetected or choose to go without a hearing aid.
- **Cultural reasons for not using hearing aids.** Another potential reason for not using hearing aids is that the deaf community at large views deafness as a characteristic of cultural identity rather than a disability (DANZ, 2001; Kudlick, 2004). Deaf parents who do not interpret deafness as a disability may not want their children to have hearing aids. However, Gallaudet Research Institute's Annual Survey indicates that only 5.6% of deaf or hard-of-hearing children have both parents who are deaf or hard-of-hearing, and another 3.2% children have one parent with hearing problems (GRI, 2005), and so the projected likelihood of this reason for not using hearing aids is assumed to be similarly low.
- **Hearing aids take patience and time to learn**. Using a hearing aid takes time and adjustment; for example, the molding may be uncomfortable at first. It also takes time for the user to become accustomed to new sounds and environments not previously perceived.

CHBRP did not identify a source that provided separate hearing aid utilization rates for those with and without insurance coverage for hearing aids. However, a survey conducted by the

Listen Up organization found that approximately 1% of respondents cited cost as a barrier to obtaining a hearing aid for a hearing impaired child (Bender et al., 2003). Based on these data, CHBRP estimates that currently about 1,090 children with hearing impairments may experience cost as a barrier in obtaining hearing aids. Cost barriers are more likely to affect individuals without coverage since those individuals will face higher out-of-pocket payments. Therefore, this translates to a 2% reduction in utilization of hearing aids as a result of lack of coverage (1,090/51,000 = 2%). CHBRP then estimates that the difference between the utilization rate for hearing-impaired children with and without insurance coverage for hearing aids would be four percentage points. As a result, CHBRP estimates a 58% rate of utilization for children *with coverage* for hearing aids and a 54% rate for children *without coverage* for the purposes of this analysis.

Behind-the-ear (BTE) hearing aids are the style of choice for most children. The price of hearing aids ranges from a few hundred dollars to more than $2,500, with linear analog hearing aids costing the least (AAO, 2006a). Due to technical advancements, analog hearing aids are currently being phased out. Based on the 2004 Hearing Review Dispenser Survey, economy BTE digital aids averaged $1,390 whereas the cost of the premium BTE digital aids averaged $2,559 (Ross, 2005).[11] Therefore, for the purposes of analysis, the estimated average cost of a hearing aid is $5,000 per pair (one for each ear).[12]

The expected lifetime of a hearing aid is generally five years (AAA, 2001). The need for new hearing aids may occur more frequently if a child's hearing status changes, but with the availability of programmable and digital hearing aids, these adjustments can be made in the audiologist's office without ordering new devices. Wear-and-tear caused by earwax and general use will affect the life span of a hearing aid.

Though many privately insured hearing-impaired children do not have coverage for hearing aids, many of them still obtain hearing aids:

- **Families make other sacrifices to obtain hearing aids for children**. A general supposition is that families forgo expenditures on other items to obtain hearing aids for their hearing-impaired children. In addition, there is anecdotal evidence to suggest that individuals without coverage may purchase hearing aids but will opt for the less expensive versions using older technology (NAAS, 1999).
- **Charities exist**. There are organizations that provide hearing aids for free or at a drastic discount, based on specified qualifications. The Miracle-Ear Children's Foundation provides hearing aids to children 16 years or younger whose families are low income but do not qualify for public support (Miracle-Ear Children's Foundation, 2004). A national hearing aid bank, called HEAR NOW, provides new and reconditioned hearing aids for people who meet financial and medical qualifications (Starkey Hearing Foundation, 2005).

[11] 2004 was the last full year for which these data is available.

[12] As discussed, per SB 1223 hearing aids are defined as, "any nonexperimental, wearable instrument or device designed for the ear and offered for the purpose of aiding or compensating for impaired human hearing, but excluding batteries and cords." Therefore this analysis does not include bone-anchored hearing aids or cochlear implants.

- **Health plans and insurers provide discounts to members or subscribers.** Although health plans and insurers generally do not cover hearing aids, some have relationships with vendors to provide a discount to their members or subscribers.

Current coverage of the mandated benefit

Current law does not specifically contain coverage requirements for hearing aids. Private health plans and insurers in California do not generally cover hearing aids themselves, although they do cover a hearing assessment to determine the need for hearing aids and medically necessary surgeries to correct hearing impairments. In the publicly insured market, both Medi-Cal and Healthy Families cover hearing aids for children at higher levels than the $1,000 proposed under SB 1223. California Public Employees' Retirement System (CalPERS) also provides coverage for hearing aids for children and the mandated benefit proposed under SB 1223 mirrors that of CalPERS.

Current coverage of hearing aids for children was determined by a survey of seven largest Knox-Keene licensed plans and insurance policies regulated by the Department of Insurance. Based on the responses of five health plans and insurers in California, few plans cover hearing aids for children.[13] Under 10% of children in large groups have coverage for hearing aids similar to the mandate (Table 6). A notable exception is that one health plan in California covers hearing aids under their durable medical equipment benefit subject to a $5,000 benefit limit for all large group medical plans. CalPERS also offers their members the hearing aid benefit of $1,000 every 36 months.

Medi-Cal and Healthy Families cover hearing aids for children. Medi-Cal, which covers 13% of children subject to the mandate in California (Table 7), provides hearing aids as a covered benefit subject to utilization controls. Medi-Cal requires that the hearing aid coverage be prescribed by a physician, licensed audiologist, or licensed hearing aid dispenser acting within the scope of practice. Healthy Families, which provides coverage to approximately 4% of children subject to this mandate, also covers hearing aids (Table 7). The program provides coverage for hearing aids at no charge every year.

Based on responses to CHBRP survey, it appears that coverage of hearing aids is not generally available in the small-group and individual market segments. Therefore, the coverage rates in those markets are estimated to be 0% for the purposes of this analysis.

Public demand for coverage

As a way to determine whether public demand exists for the proposed mandate (based on criteria specified under AB 1996 (2002)), CHBRP is to report on the extent to which collective bargaining entities negotiate for, and the extent to which self-insured plans currently have, coverage for the benefits specified under the proposed mandate. Currently, the largest public self-insured plans are CalPERS' PERSCare and PERS Choice preferred provider organization (PPO) plans. These plans include coverage for hearing aids for children, up to $1,000 per member, every 36 months. SB 1223 language is modeled on this benefit. Based on conversations

[13] These five plans represent approximately 90% of the privately insured enrollees.

with the largest collective bargaining agents in California, no evidence exists that unions currently include such detailed provisions (specific to medical devices such as hearing aids) during the negotiations of their health insurance policies. In general, unions tend to negotiate for broader contract provisions such as coverage for dependents, premiums, deductibles, and coinsurance levels. In order to determine whether any local unions engage in negotiations at such detail, they would need to be surveyed individually.

Impacts of Mandated Coverage

How will changes in coverage related to the mandate affect the benefit of the newly covered service and the per-unit cost?

The per-unit cost of hearing aids is expected to remain the same after the mandate. The $1,000 annual benefit acts as a subsidy, and members may respond by purchasing a more expensive hearing aid. Although such a subsidy may put some inflationary pressures on the per-unit cost, health plans and insurers may obtain discounts from manufacturers and wholesale distributors in the same way they obtain discounts on other medical devices.

How will utilization change as a result of the mandate?

The utilization rate for children who are not currently covered for hearing aids is estimated to increase from a current rate of 54% to 58%. This increase will put the utilization for these newly covered children on par with the rate for those who already have coverage. The utilization rates for those with coverage will stay the same (58%). As mentioned above, the estimated utilization rate increase is limited because of the following:

- Some children who are profoundly hearing impaired may not receive significant benefits by using a hearing aid.
- Some children may have hearing loss that is so mild that their hearing loss goes undetected, or they choose not to use a hearing aid.
- Cost does not appear to be a strong access barrier.

As previously discussed, the lifetime of a child's hearing aid is expected to be 5 years, and thus the mandated benefit is expected to be used once every 5 years per affected child. This is an average, as some children may need to replace their hearing aid(s) more frequently and others less frequently. For the purposes of analyzing a 36-month benefit, we assume the average child would purchase new hearing aids every 5 years. Although SB 1223 would allow members to obtain replacements every 3 years, they would still incur out-of-pocket expenditures since the $1,000 does benefit limit does not cover the full cost of the aid, which ranges from $2,800 to $5,000 per pair. Hence, we would expect members to replace the hearing aids at the end of their life span. Postmandate we would expect 400 additional children to obtain hearing aids annually who would otherwise not be able to obtain hearing aids by other means (e.g., out-of-pocket expenses, charity services, etc.). [14]

[14] See Appendix C under Mandate-Specific Caveats and Assumptions for how this was calculated.

To what extent does the mandate affect administrative and other expenses?

Administrative expenses may include the cost of setting up contracts with hearing aid dispensers or building financial arrangements for currently contracted hearing aid dispensers. Some health plans currently have existing arrangements with hearing aid dispensers to provide a discount to Medicare members.

Because SB 1223 would mandate that health plans and insurers provide the benefit once every 36 months, there may be some administrative expenses associated with setting up systems that track utilization over that time period. Typically, benefits are tracked and provided over the members' or policyholders' contract or 12-month period.[15]

Health care plans include a component for administration and profit in their premiums. In estimating the impact of this mandate on premiums, actuarial analysis (see Appendix C) assumes that health plans will apply their existing administration and profit loads to the increase in health care costs produced by the mandate. Therefore, although there may be administrative costs associated with the mandate, administrative costs *as a percentage of premium* would not change.

Impact of the mandate on total health care costs

The mandate is estimated to increase total net annual expenditures by $3.383 million or 0.01%. The mandate will increase premiums by $7.252 million ($5.012 million for the portion of group insurance premiums paid by private employers, $1.573 million for the portion of group insurance, CalPERS, and Healthy Families premiums paid by enrollees, and $667,000 for individually purchased insurance). At the same time, there is a net reduction in out-of-pocket expenditures of $3.869 million. In addition to improving the access to hearing aids for about 400 children, the premium increase will mainly go to relieve some of the cost burden for those children who need to replace their hearing aids but are not currently covered by their insurers. Actuarial analysis for SB 1223 shows that the total expenditure for hearing aids in California (including total premiums and out-of-pocket spending for co-payments and non-covered benefits) would increase by between 0.003% and 0.017% for those markets affected by the mandate. For those markets, health insurance premiums are estimated to increase *on average* by 0.013% or $0.0315 PMPM.

These estimates should be viewed as an upper bound, given that they are based on a pair of hearing aids, at a cost of $5,000 per pair, although some children may only need one hearing aid or may go with a less expensive model.[16]

[15] It is possible that a member may switch plans with the same carrier during a 3-year benefit period. To the extent to which this information is tracked among the same carrier, the benefit may be reset to the start of a 36-month period or continued. This analysis assumes no change in enrollment status. See Appendix C for caveats and assumptions related to this analysis.

[16] Based on the 1990–1991 Vital Health Statistics report, among children 3–17 years with hearing loss, 47% had bilateral hearing loss, 38% had unilateral, and the status of 15% was unknown. These data do not indicate what proportion of each category are hearing aid users. Children with either bilateral or unilateral hearing loss, especially those with bilateral loss, may get two hearing aids.

These estimates represent the overall cost for those markets affected by the mandate. It is possible that since the benefit only affects children, premiums associated with family or parent–child policies may face the premium impact whereas single (no child) policies face no premium increases for group contracts. However, because the impact of SB 1223 represents a small premium percentage increase, it is estimated that the impact would, in practice, be spread over all members in the group market. In the individual market for non-HMO plans, it is likely that increases in premiums would be smaller for adult contracts and larger for policies that cover children, specifically children with hearing loss.

Costs or savings for each category of insurer resulting from the benefit mandate

Increases in insurance premiums vary by market segment. Increases as measured by percentage changes in premiums are estimated to range from 0.007% to 0.039% in the affected market segments. Increases as measured by PMPM premiums are estimated to range from $0.0244 to $0.0596. The greatest impact on premiums would be on the small-group and individual PPO markets. A substantial portion of the increase in insurance premiums would be due to insurance absorbing a portion of the benefit's cost previously paid for by the insured. This transfer effect is discussed below.

For members with small group insurance policies, health insurance premiums are estimated to increase by approximately 0.020% (see Table 8). Given that the small-group market is not currently offering the option to purchase hearing aid coverage as a benefit, this impact may be explained by the effects of increased coverage rates (from 0% coverage to 100% coverage). In the large-group market, the coverage rates would increase from 39% to 100%, and the resulting premium impact would range from 0.007% to 0.013%. In terms of PMPM, the increase in premiums for the large-group market is estimated to range from $0.0244 to $0.0341.

Since SB 1223 would not apply to the portion of the individual market that has HMO coverage, that portion would face no impact of the mandate. The portion of the individual market enrolled in non-HMO plans is estimated to face increases in premiums of approximately 0.039%. Given that insurers may underwrite to reflect risk, increases in premiums would be smaller for adult contracts and larger for policies that cover children, specifically children with hearing loss.

CalPERS currently provides coverage for hearing aids to subscribers and their dependents, limited to $1,000 every 36 months. The benefits mandated under SB 1223 are already aligned with CalPERS' current coverage. Therefore, CalPERS is expected to face no impact if SB 1223 was enacted.

Current costs borne by payers (both public and private entities) in the absence of the mandated benefit

Impact on public programs

Medi-Cal and Healthy Families are among the few payers that cover hearing aids for children. Cost shifting to the public sector absent the benefit mandate is estimated to be limited.

No cost shifting is expected to occur from the public programs to the privately insured market if the benefit is mandated. SB 1223 would apply to health plans and insurers who provide coverage to Healthy Families and Medi-Cal managed care enrollees. Because the current coverage of these programs exceeds the mandated benefit, it is estimated that they would face no impact as a result of the mandate. Healthy Families already covers the total cost of hearing aids and ancillary items, following a hearing assessment, at no cost every year. Medi-Cal also covers hearing aids through designated hearing aid dispensers, following a hearing assessment.

Impact on privately insured members' out-of-pocket expenditures

The largest portion of the shift in benefit expenditures would be from privately insured individuals' out-of-pocket expenses to third parties. For example, in the large-group HMO market, $0.034 of the out-of-pocket expenses (measured as PMPM costs) would be expected to shift to the health plan or insurer.

Because the benefit mandate is limited to $1,000 and does not cover ancillary costs, including batteries and cords, the user would continue to incur cost at the point of purchase. In addition, any out-of-pocket costs related to adjusting the hearing aid—for example, molds to adjust the aid to the ear as the child grows—would also be incurred.

Impact on access and health service availability

As previously discussed, the mandate would increase access for individuals for whom the cost of a hearing aid was a barrier to access and for whom $1,000 every 36 months would be sufficient to eliminate that barrier. Based on the expected changes in utilization, the mandate would increase access to approximately 4% of children with hearing impairments among those children without coverage.

Another possible scenario may occur if some members relied on charity-based organizations to obtain hearing aids for children prior to the mandate. These organizations typically require the child *not* be covered for hearing aids by some other means (e.g., private or public insurance). Additionally, these agencies usually require family income to be no more than 100%–250% of the federal poverty level. Because the number of privately insured children with hearing impairments at this income category is limited, we do not expect the mandate to affect many families currently receiving charity care.

III. PUBLIC HEALTH IMPACTS

There are a number of estimates on the prevalence of children with hearing loss in the United States, with most estimates in the range of 1% to 2% of the pediatric population. Table 3 describes five different prevalence estimates that vary according to population and hearing-loss criteria. The National Institutes of Deafness and Other Communication Disorders prevalence estimate of 1.7% is used in this analysis because it applies to the most relevant population.

Table 3: Population Prevalence Estimates for Hearing Impairment

Source	**Population**	Criteria	**Estimate**
Mitchell, 2006 Survey of Income and Program Participation	Children 6–17 yrs	Difficulty understanding human speech	0.6%
Van Naarden et al., 1999 Metropolitan Atlanta Developmental Disabilities Surveillance Program	Metro Atlanta children 3–10 yrs	Serious hearing impairment	1.1%
National Institute on Deafness and Other Communication Disorders	Children under 18 yrs	Affected by hearing loss	1.7%
Ries, 1994 Vital and Health Statistics 1990-1991	Children 3–17 yrs	All levels of hearing trouble	1.8%
Niskar et al., 1998 NHANES III	Children 6–19 yrs	Self-report hearing difficulty	3.4%

Impact on community health

When used correctly, it is generally accepted that hearing aids improve hearing in children. According to the utilization estimates in the previous section of this report, it is projected that approximately 400 additional children will receive hearing aids each year as a result of SB 1223. These children are new users of hearing aids and are subsequently expected to have improved hearing due to the mandate.

In addition to improved hearing, the use of hearing aids in conjunction with educational interventions can also result in improved speech and language development (Moeller, 2000; Ramkalawan and Davis, 1992). Researchers have found that the earlier hearing loss is identified and treated, the better the outcomes are for speech and language development (Eilers and Oller, 1994; Markides, 1986;; Yoshinaga-Itano and Apuzzo, 1998a; Yoshinaga-Itano et al., 1998). Although the interventions that aim to improve speech and language development have been found to be effective, they tend to include the use of hearing aids in conjunction with other educational components not specified in SB 1223. Therefore, although the passage of SB 1223 would likely contribute to better speech and language outcomes, improvements in these areas cannot be attributed to the acquisition to hearing aids alone.

Impact on community health where gender and racial disparities exist

A literature review was conducted to determine whether there are gender or racial disparities associated with the prevalence, treatment, and outcomes for pediatric hearing loss documented in the academic literature.

Table 4 details data from 1990–1991 that show gender differences in prevalence rates for hearing loss among male and female children. Males have higher prevalence rates of hearing trouble; however, for more-severe hearing loss, the gender disparities appear to lessen (Ries, 1994). Among non-Hispanic white children, Lee et al. (1996) also found higher levels of hearing loss in males compared to females.

Beyond prevalence, a couple of studies have found that among children with hearing impairments, females have better language performance and make better use of their hearing aids compared with males (Easterbrooks and O'Rourke, 2001; Markides, 1989).

Table 4: Gender Differences among Children 3–17 Years Old with Hearing Trouble, United States 1990–1991

Gender	All Levels of Hearing Trouble (per 1,000)	Affects Speech Comprehension (per 1,000)	At Best, Can Hear Shouted Words (per 1,000)
Males	19.8	9.1	2.8
Females	16.4	8.0	2.6
Total	18.2	8.6	2.7

Source: Reis (1994) Vital Health Statistics 1990–1991.

Ries (1994) also provides information on different prevalence rates by racial and ethnic categories. The most noticeable disparity in Table 5 is that Hispanic children have a higher prevalence of hearing trouble compared to non-Hispanic children. Other researchers have also found that Hispanics have higher rates of hearing impairment, particularly among Cuban-Americans and Puerto Ricans (Lee et al., 1996; Niskar et al., 1998).

Although not evident in the national Vital Health Statistics data, studies based on the Metropolitan Atlanta population have found elevated prevalence rates of hearing loss for black children (Van Naarden et al., 1999; Van Naarden and Decoufle, 1999). As with gender disparities, the racial and ethnic differences in prevalence diminish when more stringent definitions of hearing loss are used (Lee et al., 1996; Ries, 1994).

Table 5: Racial and Ethnic Differences among Children 3–17 Years Old with Hearing Trouble, United States 1990–1991

Race or Ethnicity	All Levels of Hearing Trouble (per 1,000)	Affects Speech Comprehension (per 1,000)	At Best, Can Hear Shouted Words (per 1,000)
RACE			
White	19.4	9.3	2.8
Black	12.2	4.8	NS
Other	15.3	NS	NS
HISPANIC ETHNICITY			
Non-Hispanic	17.9	8.5	2.6
Hispanic	20.3	9.4	3.4
Total	18.2	8.6	2.7

Source: Reis (1994) Vital Health Statistics 1990–1991.
Key: NS: not a statistically stable estimate.

In addition to prevalence differences, the literature search also showed racial and ethnic disparities with regards to treatment for children with hearing loss. Kittrell and Arjmand (1997) found that white children are diagnosed with sensorineural hearing impairment earlier compared to black and Hispanic children, and this difference is independent of socioeconomic status. These findings have important implications since earlier diagnosis and intervention lead to better language abilities (Yoshinaga-Itano et al., 1998). Stern et al. (2005) also found treatment disparities with regards to receipt of cochlear implants with white and Asian children receiving implants at significantly higher rates than black and Hispanic children.

No literature was identified that discussed racial or ethnic disparities with regards to receipt of hearing aids. As such, there is no evidence to suggest that SB 1223 will have a substantial impact on racial disparities.

Reduction of premature death and the economic loss associated with disease

A literature review was conducted to determine the extent to which pediatric hearing loss results in premature death and economic loss to California, and whether AB 264 might have an impact on these outcomes.

Premature death is not a health outcome associated with hearing loss as described in the academic literature. Barnett and Franks (1999) found that after controlling for health status, adults with hearing impairments did not have mortality differences compared to non–hearing-impaired adults. Based on this information, SB 1223 will not likely have any impact on premature death associated with pediatric hearing loss.

Estimates of the lifetime costs associated with hearing loss typically focus on those with severe or profound hearing loss, and costs vary from one estimate at $297,000 per person (Mohr et al., 2000) to another at $417,000 per person (MMWR, 2004). These cost estimates include both direct and indirect costs.

The direct costs can be broken down into medical and non-medical costs. The medical costs associated with SB 1223 are specified in the Utilization, Cost, and Coverage Impacts section of this report. Non-medical direct costs for children with hearing loss primarily consist of special education costs. One estimate from the Centers for Disease Control and Prevention (CDC) indicates that 83% of direct costs and 30% of total lifetime costs associated with hearing loss for those under 18 years are attributed to non-medical direct costs (CDC, 2004).

Effective treatment of hearing loss can reduce the economic costs associated with hearing loss. Cost–benefit and cost–utility analyses have found economic benefits associated with cochlear implants due to reduced productivity costs and education costs (Cheng et al., 2000; Francis et al., 1999). However, no such analyses were identified that examined economic cost savings associated with hearing aids. As such, although it is possible that SB 1223 could contribute to decreased special education and productivity costs associated with hearing loss, there is no evidence in the literature to support this conclusion.

TABLES

Table 6. Current Coverage Levels of Hearing Aids for Children

Insurance Plan Type	Percentage with Coverage More Than Mandated Levels (1)	Percentage with Coverage Similar to Mandated Levels (1)	Percentage with No Coverage	Total
Privately insured market				
Knox-Keene licensed health plans				
Large group	30%	9%	61%	100%
Small group	0%	0%	100%	100%
Individual (2)	N/A	N/A	N/A	
Insurance policies under the California Insurance Code				
Large group	54%	1%	46%	100%
Small group	0%	0%	100%	100%
Individual	0%	0%	100%	100%
Publicly insured market				
CalPERS	0%	100%	0%	100%
Medi-Cal	100%	0%	0%	100%
Healthy Families	100%	0%	0%	100%

Source: California Health Benefits Review Program, 2006. Analysis of health plan and insurers responses to CHBRP questionnaire on current coverage for SB 1223.
Notes: (1) The mandate would require coverage for hearing aids, up to $1,000. Coverage may be restricted to one claim every 36-month period.
(2) Excluded from analysis since SB 1223 does not apply to HMOs.
Key: N/A: Not applicable.

Table 7 Baseline (Pre-Mandate) Per Member Per Month Premium and Expenditures, California, Calendar Year 2006, by Insurance Plan Type

	Large Group		Small Group		Individual		CalPERS	Medi-Cal		Healthy Families	
	HMO	PPO	HMO	PPO	HMO	PPO	HMO	HMO 65 yrs and Over	HMO Under 65 yrs	HMO	Total Annual
Population currently covered	8,237,000	1,827,000	2,593,000	1,215,000	0	1,030,000	782,000	N/A	2,423,000	714,000	19,160,000
Average portion of premium paid by employer	$202.76	$292.75	$189.45	$235.81	$0.00	$0.00	$248.33	N/A	$112.00	$75.20	$43,102,188,000
Average portion of premium paid by employee	$62.47	$77.87	$74.62	$49.58	$0.00	$137.75	$43.82	N/A	$0.00	$4.80	$13,081,166,000
Total premium	$265.23	$370.62	$264.07	$285.39	$0.00	$137.75	$292.16	N/A	$112.00	$80.00	$56,183,353,000
Covered benefits paid by member (deductibles, copays, etc.)	$9.39	$50.08	$15.90	$42.40	$0.00	$32.14	$10.35	N/A	$0.00	$2.18	$3,652,362,000
Benefits not covered	$0.13	$0.09	$0.22	$0.21	$0.00	$0.18	$0.00	N/A	$0.00	$0.00	$27,482,000
Total expenditures	$274.75	$420.79	$280.19	$328.00	$0.00	$170.07	$302.51	N/A	$112.00	$82.18	$59,863,196,000

Source: California Health Benefits Review Program, 2006.
Note: The population includes individuals and dependents in California who have private insurance (group and individual) or are enrolled in public plans subject to the Health and Safety Code, including CalPERS, Medi-Cal, or Healthy Families.
All population figures include enrollees aged 0–64 years and enrollees 65 years or older covered by employment-based coverage. Employees and their dependents who receive their coverage from self-insured firms are excluded because these plans are not subject to mandates.
Key: CalPERS = California Public Employees' Retirement System; HMO = health maintenance organization and point of service plans; PPO = preferred provider organization and fee-for-service plans.

Table 8: Post-Mandate Impacts on Per Member Per Month and Total Expenditures by Insurance Plan Type, California, Calendar Year 2006

	Large Group		Small Group		Individual		CalPERS	Medi-Cal		Healthy Families		
	HMO	PPO	HMO	PPO	HMO	PPO	HMO	HMO 65 and Over	HMO Under 65	HMO	All Plans	Total Annual
Population currently covered	8,237,000	1,827,000	2,593,000	1,215,000	0	1,030,000	782,000	0	2,423,000	714,000	19,160,000	19,160,000
Average portion of premium paid by employer	$0.0261	$0.0192	$0.0427	$0.0470	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0218	$5,012,000
Average portion of premium paid by employee	$0.0080	$0.0051	$0.0168	$0.0099	$0.0000	$0.0540	$0.0000	$0.0000	$0.0000	$0.0000	$0.0097	$2,241,000
Total premium	$0.0341	$0.0244	$0.0596	$0.0569	$0.0000	$0.0540	$0.0000	$0.0000	$0.0000	$0.0000	$0.0315	$7,253,000
Covered benefits paid by member (deductibles, copays, etc.)	$0.1159	$0.0809	$0.1906	$0.1775	$0.0000	$0.1512	$0.0000	$0.0000	$0.0000	$0.0000	$0.1027	$23,614,000
Benefits not covered	($0.1349)	($0.0941)	($0.2219)	($0.2066)	$0.0000	($0.1759)	$0.0000	$0.0000	$0.0000	$0.0000	($0.1195)	$(27,482,000)
Total expenditures	$0.0151	$0.0111	$0.0283	$0.0278	$0.0000	$0.0292	$0.0000	$0.0000	$0.0000	$0.0000	$0.0147	$3,385,000
Percentage impact of mandate												
Insured premiums	0.013%	0.007%	0.023%	0.020%	$0.0000	0.039%	0.000%	0.000%	0.000%	0.000%	0.013%	0.013%
Total expenditures	0.005%	0.003%	0.010%	0.008%	$0.0000	0.017%	0.000%	0.000%	0.000%	0.000%	0.006%	0.006%

Source: California Health Benefits Review Program, 2006.

Note: The population includes individuals and dependents in California who have private insurance (group and individual) or are enrolled in public plans subject to the Health and Safety Code, including CalPERS, Medi-Cal, or Healthy Families.
All population figures include enrollees aged 0–64 years and enrollees 65 years or older covered by employment-based coverage.
Employees and their dependents that receive their coverage from self-insured firms are excluded because these plans are not subject to mandates.
Key: CalPERS = California Public Employees' Retirement System; HMO = health maintenance organization and point of service plans; PPO = preferred provider organization and fee-for-service plans.

APPENDICES

Appendix A: Literature Review Methods

Appendix A describes the methods used in the medical effectiveness literature review for SB 1223. Although SB 1223 is identical to SB 1158, introduced in 2004 and analyzed by CHBRP staff working in conjunction with staff of the National Organization for Research at the University of Chicago, the literature review for SB 1223 was approached anew and is not an update of the previous review.

This literature review included meta-analyses, systematic reviews, randomized controlled trials, controlled clinical trials, and observational studies. The PubMed and Cochrane databases were searched. In addition, the following social sciences and educational databases were searched: PsycInfo, Sociological Abstracts, Social Sciences Citation Index, and the Education Resource Information Center (ERIC). Two business databases, Factiva and Business Source Premier, were searched for current information on costs and availability of hearing aids. Web of Science was searched for articles that cited particularly valuable older articles.

The search for medical effectiveness literature was limited to articles written in English, to studies of children, defined as subjects aged 0–18 years, and publication dates from 1980 to present. The search was limited to studies of children because differences in the characteristics of hearing loss in children make it difficult to generalize findings from studies of adults to children (Pittman and Stelmachowicz, 2003; Stelmachowicz et al., 2004).

The review focused on two major categories of studies of children with hearing loss: 1) studies of the relationship between age at initial diagnosis and treatment of hearing loss and children's speech, language, and personal/social development, and 2) studies of the relative effectiveness of hearing aids with different types of circuitry and other technologies. Attempts were made to locate studies of the effects of hearing aids on hearing, but no studies of this research question were found, perhaps because researchers who study children with hearing loss believe that it is unethical to deny children access to an intervention that many persons have found to be an effective means for coping with hearing loss (Downs and Yoshinaga-Itano, 1999).

The medical effectiveness review focused on traditional air conduction hearing aids because they are the type of hearing aids most frequently used by children with hearing loss (Gabbard and Schryer, 2003, p. 237; Palmer and Ortmann, 2005, pp. 907–908). SB 1233 may also apply to bone conduction hearing aids and vibrotactile aids, wearable devices that are used by persons who are not helped by air conduction hearing aids.[17] The review does not assess the effects of bone-anchored hearing aids or cochlear implants because SB 1223 only addresses external, wearable devices. Both bone-anchored hearing aids and cochlear implants are surgically implanted. The review also does not examine FM systems that are used in combination with hearing aids to improve children's ability to hear teachers or other speakers, because school districts typically supply these devices to children.[18] In addition, this review does not evaluate

[17] Gabbard and Schryer (2003, p. 237), Gatehouse (2002, p. 154), and Palmer and Ortmann (2005, pp. 907–908) provide further information about bone conduction hearing aids, bone-anchored hearing aids, and cochlear implants.
[18] Palmer and Ortmann (2005, pp. 911–912) describe FM systems and other assistive listening devices.

the effectiveness of screening for hearing loss or the quality of the educational interventions provided to children with hearing loss and their families, because SB 1223 only addresses coverage for hearing aids.

At least two reviewers screened the title and abstract of each citation returned by the literature search to determine eligibility for inclusion. Full-text articles were obtained, and reviewers reapplied the initial eligibility criteria.

Three hundred and five abstracts were reviewed in the literature review for SB 1223. Two hundred and seventy-two articles were not included in the analysis of SB 1223 because the articles:1) included subjects who were adults, 2) compared hearing aids to cochlear implants, 3) assessed the use of hearing aids as an adjunct to cochlear implants, 4) addressed devices other than hearing aids (e.g., cochlear implants, FM systems, tactile aids), 5) concerned the accuracy of tests of hearing loss or benefits of hearing aids, 6) discussed protocols for fitting hearing aids, or 7) examined topics other than the effectiveness of hearing aids (e.g., anatomy and physiology of the ear, characteristics of hearing loss, consequences of hearing loss, attitudes toward children with hearing loss, stress experienced by parents of children with hearing loss, and the effectiveness of educational interventions for children with hearing loss and their caregivers).

A total of 20 studies were included in the review, consisting of nine studies of the effects of early diagnosis and intervention and 11 studies of the relative effectiveness of different types of hearing aids. Additional information was obtained from 15 articles on hearing loss in children, hearing aid technologies, and other types of devices and interventions used by children with hearing loss.

The literature review did not uncover any randomized controlled trials of the effects of early diagnosis and treatment of hearing loss or of the relative effectiveness of different hearing aid technologies for children with hearing loss. One large, well-designed randomized controlled trial of three common types of hearing aid circuits was found but was excluded from the analysis because the subjects were adults (Larson et al., 2000). All of the studies of the effectiveness of early diagnosis and treatment were observational studies that did not include control groups composed of children with hearing loss who did not receive hearing aids or other interventions. Most studies examined a single group of children with hearing loss or two or more groups of children who were grouped by the age at which the children were diagnosed with hearing loss and/or fitted with hearing aids. The studies of different hearing aid technologies were also observational studies without control groups. Some studies compared a more advanced hearing aid to children's own hearing aids. Other studies compared hearing aids with two or more different types of technologies.

The designs of the studies of the relationship between age at diagnosis and intervention and speech, language, and personal/social development outcomes are not sufficient to enable one to separate the effects of early receipt of hearing aids from the effects of early receipt of educational interventions. The standard of care for children with hearing loss is fitting with hearing aids and enrollment in an early intervention program that provides education and counseling to children and their families. In most of the studies reviewed, children were enrolled in early intervention

programs at the time that they were fitted with hearing aids. One cannot determine whether the outcomes reported by the authors of these studies would be similar if the children they studied had only received hearing aids.

To "grade" the evidence for all outcome measures, the CHBRP effectiveness team uses a system[19] with the following categories:

1. Favorable (statistically significant effect): Findings are uniformly favorable, and many or all are statistically significant.
2. Pattern[20] toward favorable (but not statistically significant): Findings are generally favorable, but there may be none that are statistically significant.
3. Ambiguous/mixed evidence: Some findings are significantly favorable, and some findings with sufficient statistical power show no effect.
4. Pattern toward no effect/weak evidence: Studies generally find no effect, but this may be due to a lack of statistical power.
5. No effect: There is statistical evidence of no clinical effect in the literature with sufficient statistical power to make this assessment.
6. Unfavorable: No findings show a statistically significant benefit, and some show significant harms.
7. Insufficient evidence to make a "call": There are very few relevant findings, so that it is difficult to discern a pattern.

The search terms used to locate studies relevant to the AB 264 were as follows:

Medical Subject Headings (MeSH) for searching PubMed and Cochrane:

Hearing Aids [MAJR:NoExp] (Major emphasis in article, not exploded to include the MeSH terms for Auditory Brain Stem Implants or Cochlear Implants)
Speech-Language Pathology

All Child: 0–18 years
Publication Dates from 1980 to present

PubMed was also searched using the Related Articles feature for articles that had been identified as particularly valuable.

PubMed Search with Business Emphasis:

Hearing Aids [MeSH] with Subheadings: Economics, Statistics and Numerical Data, Trends, Utilization

[19] The foregoing system was adapted from the system used by the U.S. Preventive Services Task Force, available at http://www.ahcpr.gov/clinic/3rduspstf/ratings.htm. The medical effectiveness team also considered guidelines from the Centers for Medicare & Medicaid Services (available at http://www.cms.hhs.gov//FAC?02-MCAC.asp.#) and guidelines from the Blue Cross and Blue Shield Association (available at http://www.bcbs.com/tec/teccriteria.html).
[20] In this report, the word "trend" may be used synonymously with "pattern."

Search Terms Used in PsycInfo, Sociological Abstracts, ERIC, Social Sciences Citation Index

Hearing Aid* or Deaf or Deafness
Infant* or Child* or Adolescen* or Teenag*

Publication Dates from 1980 to present

(* means truncation)

Search Terms Used in Business Databases, Factiva and Business Source Premier

Hearing Aids
Cost or Costs or Utilization or Digital or Life Span or Price or Pricing

Publication Dates from 2004 to present

Web of Science Cited Reference Search

Web of Science database was searched for newer articles that cited 12 earlier articles that had been identified as particularly valuable.

Appendix B: Summary of Medical Effectiveness Findings on Hearing Aids for Children

Appendix B presents detailed information on medical effectiveness findings regarding the use of hearing aids for children in two tables.

Table B-1 is a summary of the published studies on two topics pertinent to SB 1223. Part 1of the table describes studies of the relationship between age at initial diagnosis and treatment of hearing loss and children's speech, language, and social development. Part 2 describes studies of the relative effectiveness of hearing aids with different types of circuitry and other features. The table includes study citations and descriptions of the types of studies, intervention and control groups, populations studied, and locations in which studies were conducted.

Table B-2, Part 1 and Part 2, is a summary of evidence of the medical effectiveness of the studies in Table B-1. The table includes study citations, results, and categorization of results.

Full bibliographic information can be found in the list of references at the end of this report.

Table B-1. Summary of Published Studies on the Medical Effectiveness of Intervention to Address Hearing Loss and Hearing Aids for Children

Part 1—Studies of the Relationship between Age at Intervention to Address Hearing Loss and Children's Speech, Language, and Social Development

Citation	Type of Study	Intervention vs. Control Group	Population Studied	Location
Apuzzo and Yoshinaga-Itano, 1995[21]	Observational study—assessed the impact of age at intervention on outcomes	Children who participated in a home-based educational intervention program whose hearing loss was identified through a newborn high-risk registry—no control group	69 children with mild to profound hearing loss who had a mean age of 40 months (3.3 years) and who did not have severe cognitive disabilities	United States—Colorado

[21] The four studies by Yoshinaga-Itano and colleagues (Apuzzo and Yoshinaga-Itano 1995, Yoshinaga-Itano and Apuzzo 1998a, Yoshinaga-Itano and Apuzzo 1998b, and Yoshinaga-Itano et al., 1998) analyzed existing data regarding children with hearing loss who were enrolled in the Colorado Home Intervention Program. The samples of children analyzed in these studies may overlap.

Citation	Type of Study	Intervention vs. Control Group	Population Studied	Location
Calderon and Naidu, 1999	Observational study—assessed the impact of age at intervention on outcomes	Participation in a program that provided audiological, educational, and related support services—no control group	Two groups of children: 80 children with bilateral hearing loss and a mean age of 36 months (3 years) and 28 children with moderately severe to profound sensorineural hearing loss and a mean age of 67 months (5.5 years)	United States—Washington State
Eilers and Oller, 1994	Observational study—assessed the impact of age at intervention on outcomes	Fitting with hearing aids	28 infants with severe or profound hearing loss	United States—Florida
Markides, 1986	Observational study—assessed the impact of age at intervention on outcomes	Fitting with hearing aids—four groups of children fitted with hearing aids (by age 6 months, by age 7–12 months, by age 1–2 years, and by age 2–3 years)	153 children who attended schools for the deaf or school units for children with partial hearing	United Kingdom
Moeller, 2000	Observational study—assessed the impact of age at intervention on outcomes	Participation in a program that provided audiological, educational, and related support services—no control group	112 children who were 5 years old and who had mild to profound prelingual-onset hearing loss; some analyses conducted for a subgroup of 80 children	United States—Nebraska

Citation	Type of Study	Intervention vs. Control Group	Population Studied	Location
Musselman et al., 1988	Observational study—assessed the impact of age at intervention on outcomes	Participation in a program that provided audiological, educational, and related support services—no control group	118 children with severe or profound hearing loss enrolled in preschool programs for hearing impaired children	Canada
Ramkalawan and Davis, 1992	Observational study—assessed the impact of age at intervention on outcomes	Fitting with hearing aids—no control group	16 children with bilateral hearing loss aged 27 months to 80 months (mean=57 months) who had hearing parents, whose first language was English, and who received services from a hospital-based hearing assessment center	United Kingdom
Yoshinaga-Itano and Apuzzo, 1998a	Observational study—assessed the impact of age at intervention on outcomes	Children who participated in a home-based educational intervention program whose hearing losses were identified by 6 months of age vs. children whose hearing losses were identified after 6 months of age—no control group	82 children who are deaf or hard of hearing with a mean age of 26 months (2.2 years)	United States—Colorado
Yoshinaga-Itano and Apuzzo, 1998b	Observational study—assessed the impact of age at intervention on outcomes	Children who participated in a home-based educational intervention program whose hearing losses were identified by 6 months of age vs. children whose hearing losses were identified between ages 7 and 18 months—no control group	40 children who are deaf or hard of hearing with a mean age of 40 months (3.3 years)	United States—Colorado

Citation	Type of Study	Intervention vs. Control Group	Population Studied	Location
Yoshinaga-Itano et al., 1998	Observational study—assessed the impact of age at intervention on outcomes	Children who participated in a home-based educational intervention program whose hearing losses were identified by 6 months of age vs. children whose hearing losses were identified after 6 months of age—no control group	150 children who are deaf or hard of hearing with a mean age of 26 months (2.2 years)	United States—Colorado

Part 2—Studies of the Relative Effectiveness of Different Types of Hearing Aids for Children

Citation	Type of Study	Intervention vs. Control Group	Characteristics	Location
Bamford et al., 1999	Observational study—repeated measures on same subjects—no control group	Two-channel hearing aid with low-frequency compression amplification and high-frequency linear amplification vs. single-channel hearing aid—no control group	25 children aged 6 to 15 years	United Kingdom
Boothroyd et al., 1988	Observational study—two interventions provided to the same children—no control group	Adjustment of high and low frequency outputs plus compression of input range vs. adjustment of high and low frequency outputs—no control group	9 adolescents aged 11 to 16 years with severe or profound prelingually acquired sensorineural hearing loss who attended a school for children with hearing impairment	United States—New York
Dreschler, 1988	Observational study- two interventions provided to the same children—no control group	Peak clipping vs. single-channel compression—no control group	16 adolescents aged 13 to 18 years with sensorineural or conductive hearing loss who attended a high school for adolescents with hearing impairment	Netherlands

Citation	Type of Study	Intervention vs. Control Group	Characteristics	Location
Flynn et al., 2004	Observational study—one intervention provided to all children—no control group	Digital hearing aid with multiple-channel, non-linear compression amplification vs. analog hearing aid—no control group	21 children aged 6 to 12.25 years (mean=9 years) who had severe sensorineural hearing loss with no conductive overlay, whose primary form of communication is oral, who attended "mainstream" schools, and who were recruited from clinics	United States—study does not report state or city
Franck et al., 1999	Observational study—three interventions provided to the same children—no control group	Compression vs. spectral enhancement vs. compression and spectral enhancement—no control group	8 adolescents aged 16 to 18 years with cochlear or mixed hearing loss who attended a school of children with hearing impairment	Netherlands
Gravel et al., 1999	Observational study—two interventions provided to the same children—no control group	Dual microphone hearing aid vs. omni-directional microphone hearing aid—no control group	20 children aged 4 to 11 years with bilateral cochlear hearing loss who were recruited through a medical school-based hearing intervention program in a large metropolitan area	United States—New York
Henningsen et al., 1994	Observational study—one intervention provided to all children—no control group	Behind-the-ear hearing aid with digital feedback suppression—no control group	10 children aged 7 to 16 years (mean=13.2 years) who had profound hearing loss who attended a school for children who were profoundly hard of hearing	Denmark

Citation	Type of Study	Intervention vs. Control Group	Characteristics	Location
Kuk et al., 1999	Observational study—two interventions provided to the same children—no control group	Digital hearing aid with a directional microphone, wide-dynamic range compression, and low compression threshold vs. analog hearing aid with an omnidirectional microphone—no control group	20 children aged 7.5 to 13.67 years of age (mean=11.3 years) with mild-to-profound sensorineural hearing loss who were recruited from elementary schools	United States—Oregon
Marriage et al., 2005	Observational study—three interventions provided to the same children—no control group	Assessed three amplification strategies used with digital hearing aids: 1) linear amplification with peak clipping, 2) linear amplification with output limiting, and 3) wide-dynamic-range compression amplification—no control group	15 children aged 7 to 15 years with severe or profound sensorineural hearing loss recruited from National Health Service audiology departments	United Kingdom
Marriage and Moore, 2003	Observational study—two interventions provided to the same children—no control group	Wide-dynamic-range compression vs. linear amplification—no control group	14 children aged 4 to 14 years with moderate to profound hearing loss	United Kingdom
Miller-Hansen et al., 2003	Observational study—one intervention provided to all children—no control group	Dynamic speech recoding hearing aids (also known as frequency transposition hearing aids) vs. child's own hearing aid—no control group	19 children aged 5.7 to 21.6 years (mean=12.5 years) with mild to profound bilateral sensorineural hearing loss who had previously worn hearing aids and who were recruited from the hearing and speech department of a children's hospital	United States—Missouri

Table B-2. Summary of Evidence of Medical Effectiveness of Interventions to Address Hearing Loss and Relative Effectiveness of Different Types of Hearing Aids for Children

Part 1—Studies of the Relationship between Age at Intervention to Address Hearing Loss and Children's Speech, Language, and Social Development

Speech Outcomes—favorable

Study	Results	Categorization (Significance, Direction)
Calderon and Naidu, 1999 (Observational study; n=80 children)	Speech production (test score): r = –0.217 in multivariate regression controlling for level of hearing loss.	Sig, fav[22]
Eilers and Oller, 1994 (Observational study; n=28 children)	Correlation between age at amplification and age at which child developed of well-formed syllables during babbling: r = 0.68 ($p<0.0001$)	Sig, fav
Markides, 1986 (Observational study; n=153 children)	Speech intelligibility (% with speech rated by teachers as very easy or fairly easy to follow): children fitted with hearing aids by age 6 months: 50%; children fitted with hearing aids at age 7–12 months: 15%; children fitted with hearing aids at age 1–2 years and 2–3 years: 10%	Sig, fav—children fitted with hearing aids by 6 months compared to all three groups of children fitted with hearing aids after age 6 months NS—all comparisons among the three groups of children fitted with hearing aids after age 6 months

[22] In studies of the relationship between age at intervention to address hearing loss and child development, "fav" indicates a finding favorable to early intervention.

Language Outcomes——pattern toward favorable

Study	Results	Categorization (Significance, Direction)
Apuzzo and Yoshinaga-Itano, 1995 (Observational study; n=69 children)	Expressive language (Minnesota CDI[23]–DQ[24] scores on Expressive Language Scale—based on parent report): intervention ≤ 2 months: adj. mean[25]=84.27 (SD=36.34), intervention 3–12 months: adj. mean=60.64 (SD=19.14), intervention 13–24 months: adj. mean=71.13 (SD=21.54), intervention 25 months or older: adj. mean=56.54 (SD=20.69) Receptive language (Minnesota CDI–DQ scores on Comprehension-conceptual Scale—based on parent report): intervention ≤ 2 months: adj. mean=87.25 (SD=29.15), intervention 3–12 months: adj. mean=73.54 (SD=23.33), intervention 13–24 months: adj. mean=78.60 (SD=28.63), intervention 25 months or older: adj. mean=66.47 (SD=15.25)	Sig, fav NS, fav
Calderon and Naidu, 1999 (Observational study; n=80 children)	Expressive language (LDS[26] score): Children with mean age of 3 years—r = –0.817 in multivariate regression controlling for level of hearing loss; children with mean age of 5.5 years—mean score is 11.15 points greater for children in the early intervention group Receptive language (LDS score): Children with mean age of 3 years—r = –0.736 in multivariate regression controlling for level of hearing loss; children with mean age of 5.5 years—mean score is 12.84 points greater for children in the early intervention group	Sig, fav – children with mean age of 3 years and children with mean age of 5.5 years Sig, fav—children with mean age of 3 years and children with mean age of 5.5 years.

[23] Minnesota CDI: Minnesota Child Development Inventory.
[24] DQ: Development Quotient Score—developmental age/chronological age.
[25] Adj. mean: adjusted for child's chronological age and cognitive ability.
[26] LDS: SKI*HI Language Development Scale.

Study	Results	Categorization (Significance, Direction)
Moeller, 2000 (Observational study; n=112 children for vocabulary skills analysis and 80 children for verbal reasoning analysis)	Receptive vocabulary skills (PPVT)[27]: r = –0.46 ($p<0.01$); effect remains statistically significant in multi-variate regression controlling for family involvement, nonverbal intelligence, and residual hearing; mean score = 94 (SD[28] = 3.1)—in range of average scores for children with normal hearing (85 to 115). Verbal reasoning (PLAI)[29]: r = -0.31 ($p<0.01$).	Sig, fav Sig, fav
Musselman et al., 1988 (Observational study; n=118 children)	Receptive spoken language (ACLC = # responses correct)[30]: Receptive language (LAB = # responses correct)[31]: Receptive mother–child communication (# responses correct) Expressive spoken language (# pictures correctly identified) Expressive mother–child communication (# responses correct):	NS—direction not stated Sig, fav—baseline NS, fav—follow-up NS—direction not stated NS—direction not stated NS—direction not stated

[27] PPVT: Peabody Picture Vocabulary Test.
[28] Standard deviation.
[29] Preschool Language Assessment Instrument.
[30] ACLC: Assessment of Children's Language Comprehension—child asked to select a picture that depicts spoken phrase.
[31] LAB: Language Assessment Battery—child asked to manipulate objects in a doll house to depict spoken sentences.

Study	Results	Categorization (Significance, Direction)
Ramkalawan and Davis, 1992 (Observational study; n=16 children)	Mean length of utterance in morphemes: r = –0.33	NS, fav
	Total utterance attempts per minute: r = –0.19	NS, fav
	Number of words spoken per minute—measure 1: r = –0.38	NS, fav
	Number of words spoken per minute—measure 2: r = –0.50	Sig, fav
	Proportion of nonverbal utterances: r = –0.35	NS, fav
	Proportion of questions asked by child (%): r = –0.48	Sig, fav
	Size of child's vocabulary: r = –0.46	Sig, fav

Study	Results	Categorization (Significance, Direction)
Yoshinaga-Itano and Apuzzo, 1998a (Observational study; n=82 children)	Expressive language (Minnesota CDI[32]–DQ[33] scores—based on parent report): intervention ≤ 6 months: adj. mean[34]=76.2 (SD=20.7), intervention > 6 months: adj. mean=56.6 (SD=18.6), p=0.001	Sig, fav
	Receptive language (Minnesota CDI–DQ scores on Comprehension-conceptual Scale—based on parent report): intervention ≤ 6 months: adj. mean=82.1 (SD=18.7), intervention > 6 months: adj. mean=58.3 (SD=34.3), p=0.002	Sig, fav
	Language (MacArthur CDI[35]—parent report of # of receptive vocabulary words and gestures): intervention ≤ 6 months: adj. mean=200.0 (SD=121.0), intervention > 6 months: adj. mean=86.4 (SD=99.5), p<0.001	Sig, fav
	Language (MacArthur CDI[36]—parent report of # expressive vocabulary words and gestures): intervention ≤ 6 months: adj. mean=116.9 (SD=117.1), intervention > 6 months: adj. mean=54.3 (SD=122.4), p<0.03	Sig, fav
	Language (# vowels and consonants produced in 30 minute interaction): intervention ≤ 6 months: adj. mean=10.0 (SD=4.1), intervention > 6 months: adj. mean=7.3 (SD=3.3), p=0.03	Sig, fav—vowels NS—consonants (direction of effect not stated)

[32] Minnesota CDI: Minnesota Child Development Inventory.
[33] DQ: Development Quotient Score—developmental age/chronological age.
[34] Adj.: Adjusted for child's cognitive ability and chronological age.
[35] MacArthur CDI: MacArthur Child Development Inventory.
[36] MacArthur CDI: MacArthur Child Development Inventory.

Study	Results	Categorization (Significance, Direction)
Yoshinaga-Itano and Apuzzo, 1998b (Observational study; n=40 children)	Expressive Language (Minnesota CDI[37]—DQ[38] score on Expressive Language Scale—based on parent report): intervention ≤ 6 months: adj. mean[39]=81.1 (SD=31.1), intervention > 18 months: adj. mean=64.3 (SD=23.9), p<0.05	Sig, fav
	Receptive Language (Minnesota CDI—DQ score on Comprehension-conceptual Scale—based on parent report): intervention ≤ 6 months: adj. mean=84.4 (SD=26.0), intervention > 18 months: adj. mean=70.1 (SD=19.7), p<0.05	Sig, fav

[37] Minnesota CDI: Minnesota Child Development Inventory.
[38] DQ: Developmental Quotient Score—developmental age/chronological age.
[39] Adj.: adjusted for child's level of hearing loss and cognitive function.

Study	Results	Categorization (Significance, Direction)
Yoshinaga-Itano et al., 1998 (Observational study; n=150 children)	Receptive Language (Minnesota CDI[40]–LQ[41] score on Comprehension-conceptual Scale—based on parent report): intervention ≤ 6 months: adj. mean[42]=79.6 (SD=25.8), intervention > 6 months: adj. mean=64.6 (SD=20.9), p<0.001	Sig, fav
	Expressive Language (Minnesota CDI–LQ score on Expressive Language Scale - based on parent report): intervention ≤ 6 months: adj. mean=78.3 (SD=26.8), intervention > 6 months: adj. mean=63.1 (SD=19.8), p<0.001	Sig, fav
	Total Language (Minnesota CDI–total LQ score based on parent report—derived from scores on the two language scales): intervention ≤ 6 months: adj. mean=79.0 (SD=25.6), intervention > 6 months: adj. mean=63.8 (SD=19.3), p<0.001; for children with normal cognition, effect remained statistically significant in analyses of covariance that controlled for eight demographic variables (e.g., mother's education, Medicaid recipient, degree of hearing loss)	Sig, fav

[40] Minnesota CDI: Minnesota Child Development Inventory.
[41] LQ: Language Quotient—language age/chronological age.
[42] Adj. mean: adjusted for child's cognitive function.

Non-verbal Understanding and Interaction Outcomes—pattern toward favorable

Study	Results	Categorization (Significance, Direction)
Apuzzo and Yoshinaga-Itano, 1995 (Observational study; n=69 children)	Situation-comprehension (Minnesota CDI[43]–DQ[44] scores—based on parent report): intervention ≤ 2 months: adj.[45] mean=95.15 (SD=35.36), intervention 3–12 months: adj. mean=82.19 (SD=24.00), intervention 13–24 months: adj. mean=91.74 (SD=24.58), intervention 25 months or older: adj. mean=85.13 (SD=20.20)	NS, fav
Yoshinaga-Itano and Apuzzo, 1998a (Observational study; n=40 children)	Situation-comprehension (Minnesota CDI–DQ scores—based on parent report): intervention ≤ 6 months: adj. mean=83.5 (SD=25.4), intervention > 6 months: adj. mean=73.3 (SD=24.4), p<0.02	Sig, fav
Yoshinaga-Itano and Apuzzo, 1998b (Observational study; n=40 children)	Situation-comprehension (Minnesota CDI–DQ scores—based on parent report): intervention ≤ 6 months: adj.[46] mean=91.9 (SD=25.4), intervention 18+ months: adj. mean=87.9 (SD=24.4)	NS, fav

[43] Minnesota CDI: Minnesota Child Development Inventory.
[44] DQ: Development Quotient Score—developmental age/chronological age.
[45] Adj.: Adjusted for child's chronological age and cognitive ability.
[46] Adj.: Adjusted for child's level of hearing loss and cognitive ability.

Personal/Social Development Outcomes—pattern toward favorable

Study	Results	Categorization (Significance, Direction)
Apuzzo and Yoshinaga-Itano, 1995 (Observational study; n=69 children)	General development (Minnesota CDI[47]–DQ[48] scores—based on parent report): intervention ≤ 2 months: adj.[49] mean=88.43 (SD=21.37), intervention 3–12 months: adj. mean=73.79 (SD=19.42), intervention 13–24 months: adj. mean=82.35 (SD=14.68), intervention 25 months or older: adj. mean=71.54 (SD=14.84) Personal–social development (Minnesota CDI–DQ scores—based on parent report): intervention ≤ 2 months: adj. mean=91.85 (SD=31.90), intervention 3–12 months: adj. mean=81.76 (SD=22.00), intervention 13–24 months: adj. mean=85.35 (SD=21.38), intervention 25 months or older: adj. mean=74.94 (SD=16.53)	Sig, fav NS, fav
Calderon and Naidu 1999 (Observational study; n=28 children)	Behavioral problems (CBCL score):[50] teacher (externalizing): intervention ≤ 13 months: mean = 47.40, intervention > 13 months: mean = 52.52 months; teacher (internalizing): intervention ≤ 13 months: mean = 49.40, intervention > 13 months: mean = 47.35 months; maternal (externalizing): intervention ≤ 13 months: mean = 48.20, intervention > 13 months: mean = 56.56 months; maternal (internalizing): intervention ≤ 13 months: mean = 44.40, intervention > 13 months: mean = 46.74 months Social-emotional development (SEAI score):[51] sociable scale: intervention ≤ 13 months: mean = 3.69, intervention > 13 months: mean = 3.40 months; impulsive	NS, not fav—all scales NS, fav—all scales

[47] Minnesota CDI: Minnesota Child Development Inventory.
[48] DQ: Development Quotient Score—developmental age/chronological age.
[49] Adj.: Adjusted for child's chronological age and cognitive ability.
[50] CDCL: Child Behavior Checklist.
[51] SEAI: Social Emotional Assessment Inventory-Preschool Version.

Study	Results	Categorization (Significance, Direction)
	scale: intervention ≤ 13 months: mean = 3.71, intervention > 13 months: mean = 3.37 months; anxious scale: intervention ≤ 13 months: mean = 3.73, intervention > 13 months: mean = 3.65	
Musselman et al., 1988 (Observational study; n=118 children)	Social development (Development Profile):	NS—direction not stated
Yoshinaga-Itano and Apuzzo, 1998a (Observational study; n=40 children)	General development (Minnesota CDI[52]–DQ[53] scores—based on parent report): intervention ≤ 6 months: adj.[54] mean=78.0 (SD=22.0), intervention > 6 months: adj. mean=67.1 (SD=19.1), p=0.002 Personal–social development (Minnesota CDI–DQ scores—based on parent report): intervention ≤ 6 months: adj. mean=83.2 (SD=25.6), intervention > 6 months: adj. mean=73.1 (SD=23.8), p=0.02	Sig, fav Sig, fav
Yoshinaga-Itano and Apuzzo, 1998b (Observational study; n=40 children)	General development (Minnesota CDI–DQ scores—based on parent report): intervention ≤ 6 months: adj.[55] mean=85.2 (SD=18.7), intervention > 18 months: adj. mean=76.0 (SD=15.6) Personal–social development (Minnesota CDI–DQ scores—based on parent report): intervention ≤ 6 months: adj. mean=91.4 (SD=27.5), intervention > 18 months: adj. mean=83.0 (SD=22.8)	NS, fav NS, fav

[52] Minnesota CDI: Minnesota Child Development Inventory.
[53] DQ: Development Quotient Score—developmental age/chronological age.
[54] Adj.: Adjusted for child's chronological age and cognitive ability.
[55] Adj.: Adjusted for child's level of hearing loss and cognitive ability.

Part 2—Studies of the Relative Effectiveness of Different Types of Hearing Aids for Children

Compression Amplification—pattern toward favorable

Study	Results	Categorization (Significance, Direction)
Bamford et al., 1999 (Observational study—2-way crossover design; n=25 children)	Speech recognition in quiet (THRIFT)[56]: 2-channel hearing aid: mean=90.4 (SD=14.5), own hearing aid: mean=87.7 (SD=18.2); treatment effect=3.3, p=0.06	NS, fav
	Speech recognition in noise (THRIFT): 2-channel hearing aid: mean=79.8 (SD=13.8), own hearing aid: mean=72.3 (SD=16.7); treatment effect=7.1, p=0.025	Sig, fav
	Child's satisfaction (maximum possible score=128): 2-channel hearing aid: mean=107.4, own hearing aid: mean=94.4; treatment effect=13.0, p=0.02	Sig, fav
	Parent's satisfaction (maximum possible score=128): 2-channel hearing aid: mean=102.7, own hearing aid: mean=86.7; treatment effect=16.0, p=0.001	Sig, fav
	Teacher's satisfaction (maximum possible score=128): 2-channel hearing aid: mean=75.9, own hearing aid: mean=65.4; treatment effect=13.0, p=0.04	Sig, fav
Boothroyd et al., 1988 (Observational study—2 interventions; n=9 adolescents)	Speech recognition (THRIFT)—average reduction in score: equalization plus compression vs. equalization: –4%	Sig, not fav
Dreschler, 1988 (Observational study, 2 interventions; n=16 adolescents)	Phoneme-identification scores for nonsense consonant-vowel-consonant words in quiet (% correct): compression: mean %=64.5%, peak clipping: mean % =49.6%; mean benefit: 15 percentage point increase	fav—results of statistical significance tests not reported

[56] THRIFT: Three-interval forced-choice test of speech pattern contrast perception

Study	Results	Categorization (Significance, Direction)
Flynn et al., 2004 (Observational study; n=21 children)	Audibility (aided sound threshold): digital hearing aid with multiple-channel, non-linear compression amplification had lower dB[57] threshold than children's own analog hearing aids, $p<0.003$	Sig, fav
	Speech recognition (scores on word recognition test): children had higher scores when using a digital hearing aid with multiple-channel, non-linear compression amplification than when using their own analog hearing aids, $p<0.05$	Sig, fav
	Child's perception of hearing aid performance (Listening Situations Questionnaire): difference in mean score for digital hearing aid with multiple-channel, non-linear compression amplification vs. child's own analog hearing aid: quiet = –0.07; noise = 0.61; distance = 0.16; outdoors = 0.61; car/bus/taxi = 0.35; television = 1.11; music = 0.87; vehicles approaching = 0.13	Sig, fav—listening in noise, outdoors, to television, and to music NS, fav—listening at a distance, in a car/bus/taxi, and to vehicles approaching NS, not fav—listening in quiet
	Parent's perception of hearing aid performance (Listening Situations Questionnaire): difference in mean score for digital hearing aid with multiple-channel, non-linear compression amplification vs. child's own analog hearing aid: quiet = 0.48; noise = 0.82; distance = 1.04; outdoors = 0.30; car/bus/taxi = 0.59; television = 0.78; music = 0.79; vehicles approaching = 0.80	Sig, fav—listening in quiet, in noise, at a distance, to television, to music, and to vehicles approaching NS, fav—listening outdoors and in a car/bus/taxi

[57] dB: decibel.

Study	Results	Categorization (Significance, Direction)
Marriage and Moore, 2003 (Observational study, 2 interventions; n=14)	Speech recognition—correctly identify pictures corresponding to spoken words: for moderate hearing loss: wide-dynamic range compression (WDRC) mean=107.5, linear amplification mean=95.8; for severe to profound hearing loss: WDRC mean=86.8, linear amplification mean=80.6 Speech recognition—correctly repeat spoken words: for moderate hearing loss: WDRC mean=88.0, linear amplification mean=68.6; for severe hearing loss: WDRC mean=79.2, linear amplification mean=73.6	Sig, fav—children with moderate hearing loss and children with severe to profound hearing loss NS, fav—children with moderate hearing loss Sig, fav—children with severe hearing loss

Study	Results	Categorization (Significance, Direction)
Marriage et al., 2005 (Observational study—3 interventions; n=15 children)	Speech recognition—correctly identify pictures corresponding to spoken words (maximum score=60): for profound hearing loss: wide-dynamic range compression (WDRC) mean=42.4 (SD=12.0), peak clipping (PC) mean=40.5 (SD=13.5), output compression (OC) mean=38.8 (SD 13.8); for severe hearing loss: WDRC lower than both PC and OC	Sig, fav—children with profound hearing loss NS, not fav—children with severe hearing loss
	Speech recognition—# of phonemes pronounced correctly (maximum score=30): for profound hearing loss: WDRC mean=16.4 (SD=7.9), PC mean=14.4 (SD=8.4), OC mean=13.7 (SD 8.7); for severe hearing loss: WDRC mean=23.7 (SD=7.1), PC mean=21.4 (SD=7.6), OC mean=20.8 (SD 8.7)	NS, fav—both children with profound hearing loss and children with severe hearing loss
	Speech recognition—words correctly recognized (maximum score=20): For profound hearing loss: WDRC mean=14.1 (SD=4.6), PC mean=13.7 (SD=6.5), (OC mean=13.6 (SD 5.5)	NS, fav—children with profound hearing loss
	Speech recognition—sentences repeated correctly in audio-visual test: For profound hearing loss: WDRC mean=61.0 (SD=7.0), PC mean=62.3 (SD=8.3), OC mean=59.5 (SD 4.4)	NS, fav—children with profound hearing loss

Multi-Directional Microphone vs. Omni-Directional Microphone—favorable

Study	Results	Categorization (Significance, Direction)
Gravel et al., 1999 (Observational study—2 interventions; n=20 children)	Signal to noise ratio that yields correct recognition of 50% of words spoken: dual-microphone = –6.0 dB (SD=4.2), omni-directional microphone = –1.3 dB (SD=4.5), p<0.001, mean benefit=4.7 dB	Sig, fav
	Signal to noise ratio that yields correct recognition of 50% of words spoken: dual-microphone = –7.5 dB (SD=4.0), omni-directional microphone = –2.8 dB (SD=4.9), p<0.001, mean benefit=4.7 dB	Sig, fav

Study	Results	Categorization (Significance, Direction)
Kuk et al., 1999 (Observational study—2 interventions; n=20 children)	Speech recognition (W-22 word lists): for children with mild-to-moderately severe hearing loss, signal-to-noise ratio improved by 5.5 dB; for children with moderate-to-severely profound hearing loss, signal-to-noise ratio improved by 8 dB Child's perception of listening difficulty (LIFE[58]: Student Inventory—0–10 point Likert Scale where 0=mostly difficult and 10=always easy): for children with mild-to-moderately severe hearing loss, median rating in 10 classroom listening situations = 7.5; for children with moderate-to-severely profound hearing loss, median rating in 10 classroom listening situations = 6.5 Teacher's assessment of learning and behavior (LIFE: Teacher Appraisal): for children with mild-to-moderately severe hearing loss, teachers for 2 of 3 children found the hearing aid tested to be highly successful or successful; for children with moderate-to-severely profound hearing loss, teachers for 3 of 6 children found the hearing aid tested to be highly successful or successful; no tests of statistical significance performed Parent questionnaire: 16 of 18 parents reported improvement in listening, 15 reported understanding of speech, 7 reported better speech production; no tests of statistical significance performed	Sig, fav— both groups of children with hearing loss NS, fav — both groups of children with hearing loss

[58] LIFE: Listening Inventory For Education.

Digital Feedback Suppression—favorable

Study	Results	Categorization (Significance, Direction)
Henningsen et al., 1994 (Observational study—pre/post; n=10 children)	Gain in hearing at high frequencies (Hz): for left ear, $p<0.01$ for 1.5k, 2k, and 3k; for right ear, $p<0.05$ for 2k, NS for 1.5k and 3k Gain in hearing at low frequencies (Hz): NS for both ears at all four frequencies (125, 250, 500, 1k)	Sig, fav—all levels for left ear Sig, fav—2k only for right ear NS

Frequency Transpositioning—favorable

Study	Results	Categorization (Significance, Direction)
Miller-Hansen et al., 2003 (Observational study—1 intervention; n=78 children)	Pure-tone average (i.e., detection of sound)—all frequencies: mean improvement over child's own hearing aid=11 dB (SD=10.7), $p<0.0001$ Speech perception (PBK Test[59]): mean improvement over score obtained when child used own hearing aid=12.5% (SD=15.7), $p=0.006$	Sig, fav Sig, fav

[59] PBK Test: Phonetically Balanced Kindergarten Test.

Spectral Enhancement—not favorable

Study	Results	Categorization (Significance, Direction)
Franck et al., 1999 (Observational study—3 interventions; n=8 adolescents)	Phoneme-identification scores for nonsense consonant-vowel-consonant words (% correct): spectral enhancement vs. unprocessed speech	NS, not fav
	Phoneme-identification scores for nonsense consonant-vowel-consonant words (% correct): single-channel compression amplification and spectral enhancement vs. unprocessed speech	NS, not fav
	Phoneme-identification scores for nonsense consonant-vowel-consonant words (% correct): multi-channel compression amplification and spectral enhancement vs. unprocessed speech ($p<0.02$)	Sig, not fav
	Phoneme-identification scores for nonsense consonant-vowel-consonant words (% correct): single-channel compression amplification and spectral enhancement vs. spectral enhancement—favors spectral enhancement alone	NS, not fav
	Phoneme-identification scores for nonsense consonant-vowel-consonant words (% correct): multi-channel compression amplification and spectral enhancement vs. spectral enhancement—favors spectral enhancement alone ($p<0.02$)	Sig, not fav
	Phoneme-identification scores for nonsense consonant-vowel-consonant words (% correct): multi-channel compression amplification and spectral enhancement vs. single-channel compression amplification and spectral enhancement—favors spectral enhancement alone (no difference)	NS, not fav

Appendix C: Cost Impact Analysis: Caveats and Assumptions

This appendix describes caveats and assumptions used in conducting the cost impact analysis. For additional information on the cost model and underlying methodology, please refer to the CHBRP Web site, http://www.chbrp.org/costimpact.html.

The cost analysis in this report was prepared by Milliman, Inc., and University of California, Los Angeles, (UCLA) with the assistance of CHBRP staff. Per the provisions of AB 1996 (California Health and Safety Code, Section 127660, et seq.), the analysis includes input and data from an independent actuarial firm, Milliman. In preparing cost estimates, Milliman and UCLA relied on a variety of external data sources. The *Milliman Health Cost Guidelines* (HCG) were used to augment the specific data gathered for this mandate. The HCGs are updated annually and are widely used in the health insurance industry to estimate the impact of plan changes on health care costs. Although this data was reviewed for reasonableness, it was used without independent audit.

General Caveats and Assumptions

The expected costs in this report are not predictions of future costs. Instead, they are estimates of the costs that would result if a certain set of assumptions were exactly realized. Actual costs will differ from these estimates for a wide variety of reasons, including:

- Prevalence of mandated benefits before and after the mandate different from our assumptions;
- Utilization of mandated services before and after the mandate different from our assumptions;
- Random fluctuations in the utilization and cost of health care services.

Additional assumptions that underlie the cost estimates presented here are:

- Cost impacts are only shown for people with insurance;
- The projections do not include people covered under self-insurance employer plans because those employee benefit plans are not subject to state-mandated minimum benefit requirements;
- Employers and employees will share proportionately (on a percentage basis) in premium rate increases resulting from the mandate. In other words, the distribution of premium paid by the subscriber (or employee) and the employer will be unaffected by the mandate.

There are other variables that may affect costs, but which Milliman did not consider in the cost projections presented in this report. Such variables include, but are not limited to:

- Population shifts by type of health insurance coverage. If a mandate increases health insurance costs, then some employer groups or individuals may elect to drop their coverage. Employers may also switch to self-funding to avoid having to comply with the mandate.
- Changes in benefit plans. To help offset the premium increase resulting from a mandate, enrollees or insured may elect to increase their overall plan deductibles or copayments.

Such changes would have a direct impact on the distribution of costs between the health plan and the insured person, and may also result in utilization reductions (i.e., high levels of patient cost sharing result in lower utilization of health care services). Milliman did not include the effects of such potential benefit changes in its analysis.

- Adverse selection. Theoretically, individuals or employer groups who had previously foregone insurance may now elect to enroll in an insurance plan postmandate because they perceive that it is to their economic benefit to do so.
- Health plans may react to the mandate by tightening their medical management of the mandated benefit. This would tend to dampen our cost estimates. The dampening would be more pronounced on the plan types that previously had the least effective medical management (i.e., FFS and PPO plans).
- Variation in existing utilization and costs, and in the impact of the mandate, by geographic area and delivery system models: Even within the plan types we modeled (HMO/POS and PPO/FFS), there are variations in utilization and costs within California. One source of difference is geographic. Utilization differs within California due to differences in the health status of the local commercial population, provider practice patterns, and the level of managed care available in each community. The average cost per service would also vary due to different underlying cost levels experienced by providers throughout California and the market dynamic in negotiations between health plans and providers.
- Both the baseline costs prior to the mandate and the estimated cost impact of the mandate could vary within the state due to geographic and delivery system differences. For purposes of this analysis, however, we have estimated the impact on a statewide level.

Mandate-Specific Caveats and Assumptions

- An estimated 109,000 children with hearing loss are in plans and insurance policies that are subject to this mandate.
- The unit cost for hearing aids is estimated to be $5,000 per pair. This assumes that most children would benefit from an aid for each ear. This estimate is an upper bound.
- The increase in the utilization of self-management training and education was estimated to be 4 percentage points (from 54% to 58%). The basis for this assumption is discussed in the *Utilization, Coverage, and Cost Impacts* section
- The life span of a hearing aid is estimated to be 5 years. The basis for this assumption is discussed in the *Utilization, Coverage, and Cost Impacts* section
- We assume that the member would replace the child's hearing aid once every 5 years, as opposed to every 36 months, since they would incur out-of-pocket costs beyond the $1,000 benefit limit at the point of purchase. The basis for this assumption is discussed in the *Utilization, Coverage, and Cost Impacts* section.
- Post-mandate we would expect 400 additional children to obtain hearing aids annually who would otherwise not obtain them due to lack of insurance coverage. This is calculated as follows:
    1) Pre-mandate there are 51,000 children with hearing loss but no coverage for hearing aids. Of these 54% are assumed to use hearing aids even without coverage (28,000).

2) Post-mandate there are he same 51,000 children with hearing loss but now with coverage. Of these 58% are assumed to use hearing aids with coverage (30,000).
3) 30,000-28,000 = 2,000 children who will newly use hearing aids
4) 2,000 children / 5 years of the expected life span of a hearing aid = 400 children who will newly use hearing aids annually.

Appendix D: Information Submitted by Outside Parties for Consideration for CHBRP Analysis

CHBRP policy includes analysis of information submitted by outside parties, and places an open call to all parties who want to submit information during the first two weeks of the CHBRP review.

No information was submitted directly by interested parties for this analysis.

For information on the processes for submitting information to CHBRP for review and consideration please visit: http://www.chbrp.org/requests.html

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A group of faculty and staff undertakes most of the analysis that informs reports by the California Health Benefits Review Program (CHBRP). The CHBRP **Faculty Task Force** comprises rotating representatives from six University of California (UC) campuses and three private universities in California. In addition to these representatives, there are other ongoing contributors to CHBRP from UC. This larger group provides advice to the CHBRP staff on the overall administration of the program and conducts much of the analysis. The CHBRP **staff** coordinates the efforts of the Faculty Task Force, works with Task Force members in preparing parts of the analysis, and coordinates all external communications, including those with the California Legislature. The level of involvement of members of CHBRP's Faculty Task Force and staff varies on each report, with individual participants more closely involved in the preparation of some reports and less involved in others.

As required by CHBRP's authorizing legislation, UC contracts with a certified actuary, Milliman, to assist in assessing the financial impact of each benefit mandate bill. Milliman also helped with the initial development of CHBRP's methods for assessing that impact.

The **National Advisory Council** provides expert reviews of draft analyses and offers general guidance on the program to CHBRP staff and the Faculty Task Force. CHBRP is grateful for the valuable assistance and thoughtful critiques provided by the members of the National Advisory Council. However, the Council does not necessarily approve or disapprove of or endorse this report. CHBRP assumes full responsibility for the report and the accuracy of its contents.

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